

MANUAL
OF
SIEGE AND GARRISON
ARTILLERY EXERCISES.
1879.

- PART I. GUNNERY.
" II. AMMUNITION.
" III. SIEGE ARTILLERY.
" IV. GARRISON GUN DRILLS.
" V. MATERIAL AND APPLIANCES.
" VI. ELEMENTARY INSTRUCTION.
" VII. MACHINES.
" VIII. MOUNTING AND DISMOUNTING ORDNANCE.
" IX. SLEIGHS.
" X. SHEERS AND DERRICKS.



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IX

REGIMENTAL ORDER.

HORSE GUARDS,

WAR OFFICE,

1st September, 1879.

THE Field-Marshal Commanding-in-Chief having approved of the instructions contained in the "Manual of Siege and Garrison Artillery Exercises," desires that they may be strictly adhered to, throughout the Service, taking effect from the 1st September, 1879.

His Royal Highness also directs that every Officer of the Royal Artillery shall provide himself with a copy thereof.

By Command of His Royal Highness the Field
Marshal Commanding-in-Chief.

R. RADCLIFFE,

Deputy Adjutant-General.

INTRODUCTORY REMARKS.

Instruction in the service of heavy ordnance, and in the various exercises connected therewith, is a subject so wide that it is impossible to enter so far into detail as to provide for every contingency.

The object, therefore, of this work has been simply to lay down such general principles as may serve as bases of instruction.

As regards elementary exercises, mounting and dismounting ordnance, &c., with a view to creating an intelligent interest in the exercise to be performed, the instructor should first explain the object in view, the means to be adopted for carrying it out, and the nature of the stores required.

Long explanations are especially to be avoided; the instructor should either place each man in the position he is to occupy at any given stage of the drill, or himself show how every operation in detail should be performed.

A portion of the lesson should be devoted to theoretical instruction, and the instructor should be careful not to dwell too long on any point of the drill.

In the performance of many of the exercises, no detail of the Nos. has been laid down, but it is to be understood that the same general duties are, as far as possible, to be performed by the same Nos.

A detachment at gun drill should on no account be permitted to *pretend* to load or lay a gun; drill stores are provided, and are to be used.

No recruit should be allowed to go to practice until he has been well instructed in laying guns, boring and fixing fuzes, and preparing shell.

To ascertain that each No. is correctly placed, the instructor should occasionally "prove" the detachment as follows:—

At "No. 1 Prove," "No. 2 Prove," &c., the No. called on should raise his right arm and extend it smartly to the front, hand open and as high as the shoulder, thumb upward; when the next No. is called, he drops his hand; at "Down" the No. last called drops his hand.

On all occasions before giving a word of command, No. 1 should repeat the number of his gun, the detachments, if there be more than one, having been numbered off for that purpose before taking post.

At "Stand fast," every No. will remain steady in the position in which he is, until "Go on" is given.

For further information on the subjects of this Manual, the following books may be consulted, viz.:

Treatise on the Construction of Ordnance, 1877.

Treatise on Military Carriages, 1876.

Notes on Ammunition, 1877.

Hand-book for Field Service, 1878.

Equipment Regulations, 1877.

Index to changes in Military Stores, 1878, *et seq.*

Notes on moving and mounting 35 and 38-ton guns, 1879.

Gunnery.

I. DEFINITION OF GUNNERY TERMS.

Calibre.—The diameter of the bore. In rifled guns it is measured across the lands.

Axis of the Piece.—An imaginary line passing down the centre of the bore.

Axis of the Trunnions.—An imaginary line passing through the centre of the trunnions at right angles to the axis of the piece.

Windage.—The difference between the diameter of the bore and that of the projectile.

Trajectory.—The curve described by the projectile in passing from the muzzle of the piece to the first point of impact.

Range.—The distance from the muzzle of the piece to the intersection of the trajectory with the line of sight.

Line of Sight.—An imaginary line passing through the sights of the piece and the point aimed at.

Line of Fire.—An imaginary line joining the muzzle of the gun and the object fired at. This term would be used instead of the preceding one if firing from behind cover or in any other case when the sights of the gun are not used.

Plane of Sight.—The vertical plane passing through the line of sight.

Angle of Sight.—The angle which the line of sight makes with the horizontal plane.

Angle of Elevation.—The angle which the line of sight makes with the axis of the piece.

Quadrant Angle.—The angle which the axis of the piece, when laid, makes with the horizontal plane. It is termed *quadrant elevation* or *depression* according as the piece is laid above or below the horizontal plane.

Line of Departure.—The direction in which the projectile is moving on leaving the piece, in other words, a tangent to the trajectory at the muzzle.

Plane of Departure.—The vertical plane passing through the line of departure.

Angle of Departure.—The angle between the line of departure and the horizontal plane. The excess of the angle of departure above the quadrant angle is commonly called the *jump*.*

* When a gun is fired, the whole system has a tendency to revolve in a vertical plane round the point of the trail or rear trucks; this lifting in front gives rise to the "jump."

Gunnery.

Angle of Projection.—The angle between the line of departure and the line of sight.

Angle of Descent.—The angle which a tangent to the trajectory at the first point of impact makes with the horizontal plane.

Lateral Deviation.—The perpendicular distance of the point of impact of the projectile right or left of the plane of sight.

Drift.—The constant deflection of a projectile from the plane of departure due to the rotation imparted by the rifling of the piece. It is sometimes termed *derivation*.

Point Blank.—A gun is laid point blank when the line of sight is parallel to its axis. Point blank range is the range due to the jump of the gun.

Muzzle Velocity.—The velocity in feet per second with which a projectile leaves the piece from which it is fired.

Remaining Velocity.—The velocity of a projectile at any given point of its trajectory.

Striking Velocity.—The velocity of a projectile at the point of impact.

Terminal Velocity.—The maximum velocity which it is possible for a given projectile to acquire by falling through the air.

The following are the natures of artillery fire :

1. WITH REFERENCE TO THE VERTICAL PLANE.

Direct Fire.—Fire from guns with service charges at all angles of elevation not exceeding 15° .

Indirect or Curved Fire.—Fire from guns with reduced charges and from howitzers and mortars at all angles of elevation not exceeding 15° .

High-Angle Fire.—Fire from guns, howitzers and mortars at all angles of elevation exceeding 15° .

2. WITH REFERENCE TO THE HORIZONTAL PLANE.

Frontal Fire.—The line of fire perpendicular to the front of the object fired at.

Oblique Fire.—The line of fire inclined to the front of the object fired at.

Enfilade Fire.—The line of fire parallel (or nearly so) to the front of the object fired at.

Reverse Fire.—When the rear instead of the front of the object is fired at.

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Gunnery.

II.—THE GUN.

The principal questions to be decided in the construction of ordnance are the following :—

1. The best material for ordnance.
2. The best system of rifling.
3. Muzzle or breech-loading.
4. The proportion of weight to calibre.

1. Long experience has taught us that the metals available for the manufacture of guns are practically limited to cast iron, wrought iron, steel and bronze.

Cast iron has great hardness but comparatively little tenacity.

Wrought iron is comparatively soft but possesses great tenacity and ductility.

Steel has the good qualities of both the preceding without their defects, but is considered uncertain in its strength by our authorities.

Bronze is soft but tough and tenacious.

The service rifled guns are now constructed by shrinking coils of wrought iron over a tube of steel. The hard metal thus forms the bore and the softer wrought iron not only gives support to the steel, but prevents the gun bursting explosively in case the tube is fractured.

The 7-pr. mountain gun is the only one which is entirely made of steel.

Many of the Armstrong breech-loaders and the earlier patterns of 64-pr. R.M.L. guns are constructed entirely of wrought iron.

Cast iron strengthened by an internal tube of wrought iron is the material of the converted 64-pr. and 80-pr. R.M.L. guns.

There is one pattern of 7-pr. of bronze.

All the metals are thus represented in our rifled guns.

The French* and some other nations have heavy rifled guns of cast iron strengthened by hoops of steel over the breech.

The Germans use steel, their heavy guns having hoops of the same metal forced or shrunk on over the breech.

The Austrians have recently adopted the so-called steel bronze for their field artillery. The metal is cast in chill and the surface of the bore rendered more dense by forcing slightly coned mandrils down it.

Russia used a large proportion of bronze guns during the late war with Turkey, but has since given Krupp large orders for steel guns.

Many foreign nations have purchased guns from Krupp as well as from Sir W. Armstrong, so that specimens of every variety of construction may be found abroad.

* The French guns are lined with steel at the breech end.

Gunnery.

2. RIFLING.

The object of rifling a gun is:—

1. To increase its accuracy.
2. To increase its range.
3. To enable us to fire a shell of the same weight as that of the smooth-bore gun, from a much lighter gun, or a heavier shell from a gun of the same weight.

1. Accuracy. A shot from a smooth bore leaves the gun rotating round an axis dependent on the position of the centre of gravity of the shot or the portion of the bore last touched. This rotation is uncertain in its direction and the deviation due to it cannot therefore be corrected. In a rifled gun the grooves impart a definite rotation to the projectile which gives it a lateral deviation or drift which, being constant, can be corrected and the accuracy of the gun thus increased.

2. For projectiles of the same weight the resistance of the air increases as the square of the diameter. An elongated projectile which is kept point first during flight by the rotation imparted to it by the rifling will therefore range farther than a spherical one of the same weight. For instance, if two 12-lb. shot start with a velocity of 1600 feet, the spherical one (4.45 inches in diameter) will have a remaining velocity of 753 feet at 1000 yards, whereas the elongated shot (3 inches in diameter) will have a remaining velocity of 1166 feet at the same range.

3. The 9-pr. R.M.L. gun of 6 cwt., carries 40 rounds and weighs 33 cwt. when equipped for service, and is a more efficient weapon in every way than the 9-pr. S.B. gun of 13½ cwt. which only carried 32 rounds and weighed equipped for service 40 cwt. The 16 pr., which throws an 18-lb. shell, weighs 1½ cwt. less than the 9-pr. S.B. gun.

The various systems of rifling which have been or are now in use, may be classed as follows:—

1. Breech-loaders with projectiles having soft metal coating or rings, larger in diameter than the calibre of the gun, and forced into the grooves on the discharge of the gun.

Examples. The service Armstrong B.L. and German system.

2. Breech or muzzle-loaders, with hard projectiles depending for their rotation on mechanical fit.

Examples. The Whitworth and Lancaster systems.

3. Muzzle or breech loaders with projectiles having a sabot attached to their base which is expanded into the grooves on the discharge of the gun.

Examples. The service 6.3-inch howitzer and the new Armstrong B.L. guns.

Gunnery.

4. Muzzle-loaders with projectiles having studs or ribs to fit the grooves.

Example. Our present R.M.L. guns.

1. The first of the above systems centres the projectile the most perfectly, i.e., it leaves the bore with its axis stable. The twist of the grooves can therefore be less than in the other systems, and the strain, both on gun and projectile, be proportionally reduced. The Armstrong system, however, from the shape of the grooves and the thickness of the lead coating on the projectiles, gives considerable pressures. Lead coated projectiles are liable to damage in transport and to deterioration in store, they foul the bore, necessitating the use of a lubricant, and the lead coating, unless chemically attached, is liable to become detached from the projectile in flight. Projectiles fitted with copper driving rings have not these disadvantages.

2. The second system throws an excessive strain on both gun and projectile. If the projectile does not fit the bore accurately it makes indifferent practice, if it does "jams," may occur in loading.

3. The third system promises to give many of the advantages of the breech-loader, such as centering the shell and consequent accuracy, to the muzzle-loading gun. The grooves being numerous and shallow and the projectile an easy fit in the bore, there is comparatively little strain on the gun. The sabots (or rotating gas checks) can be carried separate from the shells, thus reducing the chance of injury in transport to a minimum. The following practice gives a direct comparison of the 3rd and 4th systems. It was carried out at Shoeburyness with two 6.3-inch howitzers, one rifled with 5 plain grooves, uniform twist 1 in 16 calibres, shell with studs, the other with 20 shallow grooves, twist 1 in 100 to 1 in 35 calibres, shell with a copper cup-shaped sabot or gas check attached to its base.

				Mean Range.	Mean error in Range.	Mean error in Direction.
Charge 4 lbs. Elevation 15°	{ 5 groove howitzer ..	polygroove ..	..	2,871	40.8	3.28
				3,164	18.6	1.32
Charge 2 lbs. Elevation 35°	{ 5 groove ..	polygroove ..	..	2,159	29.2	7.6
				2,801	11.0	1.53

4. The 4th system includes all the R.M.L. guns in our service. Its defects are that the gun is weakened by the deep grooves cut into it, and the projectile being imperfectly centred, does not shoot well unless the twist of the grooves is greater than would otherwise be necessary. The bore of the gun is liable to deterioration after a number of rounds by the rush of gas over the shot. This defect has been to a great extent overcome by the use of gas checks, which are copper discs attached to the base of the shot.

Gunnery.

By this combination of No. 3 and 4 systems, the shooting of most of our heavy guns has been greatly improved, as shown by the following practice which was carried out at Shoeburyness on the 7th May, 1874, from a 9-inch R.M.L. gun, charge 50 lbs. P powder, elevation 5° .

	Mean Range.	Mean error in Range.	Mean error in Direction.
	Yds.	Yds.	Yds.
Palliser shot without gas check	2,853	73.6	8.38
„ with gas check	3,003	24.0	0.84

The various modifications of No. 4 system of rifling in our service are:—

1. The French, applied to the 7-pr.
2. The modified French, 9-pr. and 16-pr.
3. The Woolwich, which is also a modification of the French, to the 80-pr. and upwards, and also to the 25-pr., 40-pr., and 8-inch howitzer.
4. The Shunt. Now nearly obsolete, but still existing in some 64-pr. guns.
5. The plain groove. This is really the narrow and deep portion of the shunt groove. It is applied to all 64-pr. converted guns, to Mark III. wrought iron 64-pr. and to Mark I. and II. of the same calibre when re-tubed.

To recapitulate.

There is less strain on a gun: the greater the number of grooves, the shallower they are and the less rapid their twist, and the more easily the projectile is started.

The twist must be sharper: the longer the projectile, the less perfectly it is centred, the lower its muzzle velocity, the shorter the gun and the longer the range at which it is intended to be used.

The more numerous the grooves the shallower they may be.

3. MUZZLE OR BREECH-LOADING.

Muzzle-loading guns have been adopted in the service on account of their greater simplicity, a quality which is held to outweigh the advantages claimed for the breech-loaders, the principal ones being greater cover for the gun detachments and greater accuracy.

By the adoption of overbank carriages, jointed rammers, &c., for our siege guns, as much, if not more, cover has been obtained for the detachments working them than in breech-loading guns, and No. 3 system of rifling bids fair to put the muzzle-loaders on a par with breech-loaders as regards accuracy of fire.

Gunnery.

4. PROPORTION OF WEIGHT TO CALIBRE.

Two incompatible qualities are required from guns—the maximum of effect and the maximum lightness.

The first involves the use of heavy shells with large bursting charges and high velocities. To obtain the velocity large charges of powder must be used. The weight of the gun, carriage, &c., must therefore be proportionally great.

The second quality, which is of especial importance in field and siege artillery, is opposed to the use of heavy charges with heavy shells. If a heavy charge is used the shell must be light and *vice versa*.

Hence the necessity for different calibres and the three natures of ordnance, viz., guns, howitzers and mortars.

III.—THE CHARGE.

GUNPOWDER AND ITS ACTION IN THE BORE OF A GUN.

Gunpowder is an intimate mechanical mixture of saltpetre, sulphur and charcoal in the following proportions: 75 saltpetre, 15 charcoal, 10 sulphur.

It depends for its effect on the elastic force developed by the sudden evolution of a large volume of gas. This gas is chiefly derived from the combustion of the carbon (charcoal) in the oxygen contained in the saltpetre. It would, if it could be fully expanded at the moment of explosion, occupy a space about 2,000 times as great as that of the powder from which it was resolved. The action of the sulphur is to lower the point of ignition of the powder and to increase the temperature and rapidity of combustion, thus increasing the volume of the gases by expansion.

The great advantage of gunpowder over other explosives (from a gunnery point of view) is the comparative slowness of its combustion, whereby the strain on the gun is reduced, and the power we have (by modifying the density, size of grain, &c.) of regulating the rapidity of this combustion to a very great extent.

The chief disadvantages of gunpowder are the smoke and dirt attending its explosion.

The force of fired gunpowder has been very variously estimated as a glance at the following table will show:—

1743.	Robins, 1,000 atmospheres, or $6\frac{1}{2}$ tons per square inch.
1778.	Hutton, 2,000 atmospheres, or $1\frac{1}{3}$ tons per square inch.
1797.	Rumford, 100,000 atmospheres, or 650 tons per square inch.
1859.	Piobert, 5,000 to 12,000 atmospheres, or $32\frac{1}{2}$ to 78 tons per square inch.
1874.	Abel and Noble, 6,400 atmospheres, or 42 tons per square inch.

(A. M.)

B

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When gunpowder is fired in a space entirely confined—

1. The products of combustion consist of about 57 per cent. by weight of matter, which ultimately assumes the solid form, and 43 per cent. by weight of permanent gases.

2. The gases generated by the explosion occupy (when cooled down to the freezing point and at the normal barometric pressure) about 280 times the volume of the original powder.

3. The temperature of the explosion is about $2,200^{\circ}$ C. ($4,000^{\circ}$ Fahrenheit).

4. The tension of the products of combustion is about 6,400 atmospheres or 42 tons per square inch.

5. The composition of the solid residue is very variable. It consists principally of the following substances—

Potassium carbonate (K_2CO_3) 50 to 60 per cent.

„ sulphate (K_2SO_4) 10 to 15 per cent.

„ hyposulphite ($K_2S_2O_4$) 4 to 30 per cent.

„ monosulphide (K_2S) 2 to 19 per cent.

6. The permanent gases consist of—

Carbonic anhydride (CO_2) about 50 per cent.

Nitrogen (N) about 33 per cent.

Carbonic oxide (CO) about 12 per cent.

and smaller proportions of sulphuretted hydrogen, marsh gas, and hydrogen.

When gunpowder is fired in the bore of a gun—

1. There is a reduction of temperature due to the expansion of the permanent gases, but this is in a great measure compensated for by the heat stored up in the liquid residue.

2. The total theoretic work of gunpowder when indefinitely expanded is 486 foot tons per lb. of powder. (The work stored up in 1 lb. of coal is about ten times as great.)

3. The products of explosion, at all events as far as regards the proportions of the solid and gaseous products, are the same as in the case of powder fired in a close vessel.

The following are the principal circumstances which influence the force exerted by gunpowder:—

1. Quality of the ingredients.

2. Proportion of the ingredients.

3. Density of the powder.

4. Hardness of the powder.

5. Proportion of moisture.

6. Size of grain.

7. Amount of space occupied by the charge in the bore of a gun.

8. Point of ignition of the charge.

9. Length of bore of the gun.

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10. Calibre.
11. Amount of the charge.
12. Weight of the projectile.
13. Windage.
14. Rifling.

1. QUALITY OF THE INGREDIENTS.

One of the greatest difficulties of the powder maker in his endeavours to produce an uniform powder is the variability of the charcoal. The chemical constitution of the woods from which it is produced is affected by the climate in which the wood is grown and even by the time of year in which it is cut. The nature of the charcoal itself can be modified to almost any extent in process of manufacture by varying the heat to which it is subjected and the length of time it is exposed to this heat. Under-burnt charcoal is more easily inflammable, but is more hygroscopic than charcoal which has been burned the usual time. It therefore makes a strong powder, but one which is liable to lose its strength by absorbing moisture from the air.

With regard to the other two constituents of powder (sulphur and saltpetre) there is no great difficulty in reducing them to a pure state and thus ensuring uniformity of quality.

2. PROPORTION OF THE INGREDIENTS.

A slight increase in the proportion of sulphur increases the rapidity and temperature of combustion, and therefore the pressure. A slight diminution in the proportion of saltpetre diminishes both velocity and pressure.

3. DENSITY OF THE POWDER.

The denser the grains of a powder, i.e. the higher their specific gravity, the more slowly they will burn, the less the pressure they will exert in the bore of a gun and the less the velocity they will impart to the projectile.

In a 10-inch gun a 70 lb. charge gave the following result.

Density.	M. V.	Max. pressure in tons per square inch.
1.732	1,474	29
1.782	1,432	21

(A. M.)

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4. HARDNESS.

Hardness is independent of density; its effect is to retard the ignition of the powder. It can be produced by pressing the powder when moist. An excess of moisture would however be liable to render the powder grains porous, the water in escaping under pressure forming pores in the press cake. A porous powder would ignite more easily and burn quicker than a powder without pores.

5. PROPORTION OF MOISTURE.

The effect of moisture in powder appears to be to reduce the temperature of explosion by the steam developed and thus to reduce both the pressure and the velocity.

In an 8-inch R.M.L. gun firing a shot of 180 lbs. with a charge of 35 lbs., a powder with 0.7 per cent. of moisture gave a M.V. of 1545 f. s., and a maximum pressure of 22.02 tons, the same powder with 1.55 per cent. of moisture gave a M.V. of 1495 f. s., and a maximum pressure of 17.55 tons.

An increase of less than 1 per cent. of moisture thus decreased the M.V. by 50 feet and the pressure about 20 per cent.

6. SIZE OF GRAIN.

The larger the grain the longer each individual one will take to burn, but as the interstices between the grains increase with their size there is more space for the flame to pass between them and the whole charge will be more rapidly ignited. The pressure in the powder chamber will therefore be more uniform with a large grained powder. With a small grained powder a large volume of gas is generated at the point of ignition of the charge, this rushes violently through the interstices of the charge and between it and the bore and gives rise to what is called a wave action and intense local pressures.

7. AMOUNT OF SPACE OCCUPIED BY THE CHARGE IN THE BORE.

The greater the space occupied by a given charge in the bore of a gun, the less will be both the pressure and the velocity. But, by increasing the charge at the same time as the amount of space per pound of powder occupied by it, the velocity may be increased without any corresponding increase of pressure.

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Examples.

Gun and charge.	Cubic inches to lb. of Powder.	M. V.	Pressure on chamber.	
			Mean.	Maximum.
12·5-in. Gun of 38 tons ..	130 lbs. P 2 ..	24·6	1,450	24·4
800 lbs. shot ..	130 lbs. P 2 ..	30·0	1,391	25·4
with gas check	180 lbs. P 2 ..	30·0	1,541	19·1
12-pr. R.M.L. Gun, 12 lbs. shell	8·0 lbs. ..	28·6	1,686	22·4
	3·0 lbs. ..	37·8	1,515	17·7
	3·25 lbs. ..	37·09	1,552	10·9
	3·5 lbs. ..	36·4	1,609	10·7
				11·5

It was also found with the 12-pr. gun that when the 3 lb. charge was rammed to a length of 8 ins. so as to completely fill the chamber, the observed velocity at 40 yards from the muzzle was 1674 f. s., when it was rammed to length of 11 in. the velocity fell to 1535 f. s.

It is probable that, with very small grained powders such as L.G., the velocity of the projectile would be reduced, instead of increased, by allowing the cartridge completely to fill the chamber, as the small interstices between the grains would not allow the flame to pass with sufficient rapidity to ignite a large proportion of the charge before the shot moved.

8. POINT OF IGNITION OF THE CHARGE.

It has been found by experiment that the highest velocity is obtained by igniting the cartridge at about $\frac{1}{10}$ of its length from the rear. The larger the grain of the powder the less is the difference in velocity when the cartridge is ignited at different points.

9. LENGTH OF BORE OF THE GUN.

Up to a certain point, which can never be reached in practice (i.e. when the retarding forces on the shot equal the accelerating force of the gas), the longer the gun the greater will be the work obtained from a given charge of powder. The effect will be more marked with a slow than with a quick burning powder.

It was found that the muzzle velocity of the 12-inch of 35 tons was increased nearly 5 per cent. by adding 3 feet to the length of the gun.

The length of muzzle loading guns is limited by considerations of loading, &c., that of breech loaders can be increased to almost

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any desired extent. The latter guns have therefore the advantage in this respect.

10. CALIBRE.

With the same charge and weight of projectiles, an increase of calibre gives an increase of muzzle velocity; the reason being, that an increased area of the projectile is exposed to the pressure of the powder gas.

11. AMOUNT OF THE CHARGE.

When a charge of any description of powder is increased beyond a certain limit, wave or local pressures are set up which strain the gun unduly without affording an equivalent or useful effect on the projectile.

The charge may however be increased beyond this limit—provided the gun is long enough:—

- a. If the space occupied per pound of powder is also increased.
- b. If a larger grained powder be used.

12. WEIGHT OF THE PROJECTILE.

When the weight of the projectile is increased, the velocity is reduced, but the pressure only slightly increased. As, however, the pressure is exerted for a longer time, it has a more destructive effect on the gun.

It has been found that in the 10-inch gun, with a charge of 60 lbs., R.L.G., the work realised from the powder is only increased by about 5 per cent. when the weight of the shot is doubled. With a charge of 70 lbs. P the work realised is increased $8\frac{1}{2}$ per cent. when the weight of the shot is doubled, but when it is again doubled (*i.e.* four times its original weight), the additional effect is barely 1 per cent.

13. WINDAGE.

No experiments have been made to determine the loss of velocity in rifled guns with projectiles having different windages.

Major Mordecai's experiments with smooth-bore guns showed that the loss of velocity by windage is proportional to the windage.

The Committee on Explosives found that "The use of copper gas checks in the 38-ton gun, when firing 130-lb. charges of P 2 powder, and 800-lb. projectiles, gives an increase in muzzle velocity

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of about 38 feet per sec. over that obtained with a projectile of the same weight with service windage fired with the same charge; a gain equivalent to an increase in the length of the bore of about three calibres. This increase is evidently due to the sealing of the windage by the gas check, whereby the pressure in the powder chamber is increased slightly, while there is also an increased pressure on the base of the shot."

There is also an escape of gas through the vent when a gun is fired, by which a small proportion of velocity is lost.

14. RIFLING.

Experiments seem to show that there is little difference in either velocity or pressure in a smooth bore and a rifled gun of the same calibre, and firing the same charge and weight of projectile.

It has been calculated that the increase of pressure due to rifling in the 10-inch gun is only .08 ton per square inch.

IV.—INSTRUMENTS FOR MEASURING PRESSURE AND VELOCITY.

The force of fired gunpowder is estimated by the pressure it produces in the bore of the gun, and the velocity it imparts to the projectile. The object sought after in all recent experiments, is to obtain the maximum velocity and minimum pressure. The Committee on Explosives have laid down 25 tons per square inch as the maximum pressure allowed in heavy guns.

The instruments that have been used to measure these effects are the following:—

1. INSTRUMENTS FOR MEASURING THE PRESSURE OR VELOCITY IN THE BORE OF A GUN.

In 1845, General Cavalli proposed to measure the pressure in the bore by screwing a series of small barrels into the gun, at various distances from the bottom of the bore. Balls were inserted in these barrels, and by measuring the velocity imparted to them by the charge of the gun, the pressure in the bore was calculated. General Cavalli appears to have estimated the pressure at a very high rate.

In 1854 a Prussian Artillery Committee tried a modification of Cavalli's plan, in field guns, and obtained some fairly reliable results.

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About 1857, Major Rodman invented his pressure gauge. This consists of a tube screwed into the gun in any required position, the open end of the tube being flush with the bore. The upper part of the bore of the tube is enlarged, and contains a gas-tight piston, which carries a knife; a piece of copper is pressed tightly against the knife by a screw, which closes the upper end of the tube. When the gun is fired, the knife is forced into the copper, and the indent produced is a measure of the pressure on the base of the piston. The Committee on Explosives found that no great dependence could be placed on the results obtained with the Rodman gauge, for the following reasons: "The shape and size of the coppers and knives render it imperative to place them at the upper extremity of the plug, and consequently on the exterior of the gun; the gas has therefore a considerable space to travel through between the powder-chamber and the instrument; thus, before reaching the latter, it has attained a high *vis viva*, especially in quick burning powders; this is transferred to the knife, and the recorded pressures are therefore always much higher than should be the case. This was clearly shown by placing a copper cylinder in one of the Rodman gauges, and comparing its compression with that of a similar cylinder taken from the crushing instrument." The pressures shown were 40 and $22\frac{1}{2}$ tons per square inch respectively.

The above-mentioned defects of the Rodman gauge led the Committee to devise a modification of it, which has been used in all their experiments. It is called the "crusher" gauge, *vide* R.G.F. Treatise on Ordnance, page 338. Instead of the knife and copper, there is a piston and small copper cylinder, the pressure being measured by the compression of the latter. The diameter of the working parts of the instrument is also reduced, and permits of their being placed near the surface of the bore. Crusher gauges have also been applied to the bases of projectiles, and (in service guns) fitted to copper cups placed at the bottom of the bore.

The chronoscope, invented by Captain A. Noble, is intended to measure the velocity of a projectile at various points in the bore, whence the pressures necessary to produce the observed velocities may be calculated.

This instrument consists of a number of thin discs, 36 inches in circumference, keyed to a shaft and made to revolve at a high and uniform velocity—usually arranged at about 1,100 inches a second. Each disc is furnished with an induction coil, the primary wire from which is conveyed to any point in the gun where we may wish to record the instant at which the shot passes. At each such point there is a special contrivance by which the shot, in passing, severs the primary wire, thereby causing a discharge from the secondary. The spark records itself on the edge of the disc. The instrument is capable of recording the millionth part of a second, and when in good working order, the error should not exceed four or five millionths of a second.

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2. INSTRUMENTS FOR MEASURING THE VELOCITY OF A
PROJECTILE OUTSIDE THE BORE OF A GUN.

Of the various instruments for taking the velocity of projectiles before the application of electricity to this purpose, the most notable is the ballistic pendulum invented by Robins in 1743. It consisted of an iron plate faced with wood and suspended from a tripod. The gun was fired at the pendulum and the velocity of the ball computed from its oscillations.

Ballistic pendulums on the same principle but with many improvements were subsequently made both in this country and abroad. One as lately as 1855 by Messrs. Armstrong & Co.

Wheatstone was the first (in 1870) to propose the application of electricity to measure the velocity of projectiles, and his idea was quickly taken up, but the early instruments were nearly all very complicated, and their results could not always be depended upon.

Major Navez of the Belgian Artillery was the first to produce a really efficient instrument. Its principle is as follows: the shot passes through two screens placed a certain distance apart, and successively breaks two electrical circuits, the first break causes a suspended pendulum to fall, the second clamps a pointer attached to the pendulum. The position of the pointer on a graduated arc is read and from this the velocity of the shot is calculated.

This instrument was subsequently improved in its details by Col. Leurs, and was then known as the Navez-Leurs chronograph.

It is now superseded by a chronograph invented by Major Le Boulengé, also of the Belgian Artillery. The Le Boulengé chronograph differs from the Navez chiefly in the substitution of a freely falling weight for the pendulum. By means of a scale the velocity of the shot can be read off at once without any calculation.

In the above three instruments the velocity of the shot can only be measured between two points, in the two following, it can be measured between any number of points.

Professor Bashforth's chronograph (used by him in his investigation on the resistance of the air to the motion of projectiles) consists of a vertical cylinder which is made to revolve. Close to the cylinder is a small platform, carrying two electro magnets and a marker in connection with each, which, when the instrument is set in action is allowed to descend slowly.

The markers are in contact with the cylinder and thus describe a spiral on it. One of the markers is connected with a clock and records seconds of time, the other is connected with the screens and records the passage of the shot through each screen.

The shot in passing through each screen breaks and almost instantaneously remakes the current, causing the marker to make a slight deviation from the spiral. After the round is fired the paper with which the cylinder is covered is removed and the velocity of the shot at the various screens calculated from a comparison of the screen and time records.

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Captain Watkin's chronograph consists of two upright brass cylinders, which are blackened before an experiment. A metal weight is suspended by an electro magnet between the cylinders. The registration is effected by sparks from an induction coil during the free fall of the weight. The action of the instrument is this:—"The weight being released a short time before the gun is fired, descends between the cylinders; the shot, on passing through the first screen, breaks the continuity of the primary wire of the coil, thus causing an induced spark to pass from one cylinder to the other through the brass wire of the weight—this being its shortest path. A minute spot registers the exact position of the weight at that moment. The weight continuing to fall, as the shot passes the second screen (the primary current being in the meantime re-established) the same result follows; and so for any number of screens. The distance between the spots, as read off on the velocity scale, gives the time taken by the shot to pass the various screens. By means of the calculating scale the velocity may be at once ascertained for any distance between screens. For a fresh experiment all that is required is to turn the cylinders slightly round and again suspend the weight."

V.—THE PROJECTILE.

1. FORCES ACTING ON A PROJECTILE IN THE BORE OF A GUN.

These have already been treated of in the last section. They may be briefly summed up as follows:—

a. The Force of Projection of the Powder-Gas.

The forward velocity, or velocity of translation, attained by a projectile at the muzzle of a gun, is due to the sum of the pressures of the powder-gas during its passage through the bore. The more gradually this velocity is imparted to the projectile the less will be the strain upon it. The object sought after in recent experiments is to distribute, as far as possible, the pressure over the whole length of the bore and to obtain the maximum work from a given charge of powder without undue strain on either gun or projectile. A theoretically perfect result would be obtained if the last atom of powder were converted into gas as the projectile was leaving the muzzle.

b. The Rotation imparted to the Projectile by the Grooves.

There is less strain on a projectile the greater the number of the grooves, the less their twist and the more gradually the rotation is imparted.

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The force required to produce a given rotation being definite, the greater the number of grooves the less will be the strain exerted by each individual one on the driving surfaces of the projectile.

It is the first blow of the powder-gas that exerts a destructive effect on the projectile, the more easily therefore the latter can be started the less the strain on it. Hence the advantage of the increasing over the uniform twist. There is, however, a slight loss of velocity with the increasing twist due apparently to two causes—(a) the friction between the edges of the grooves and driving surfaces of the projectile is greater, the pressure between them being distributed more uniformly throughout the bore, although the maximum pressure is much less; (b) the facility with which the projectile can move leads to less powder being burned before it starts and the total pressure in the bore is therefore somewhat less.

If a projectile is not perfectly centred it is liable in its passage through the bore to be driven violently from side to side of it. It is thus unduly strained and its axis becomes unstable.

2. FORCES ACTING ON A PROJECTILE DURING FLIGHT.

The chief forces acting on a projectile during its flight are—

- a. The force of projection.
- b. The force of gravity.
- c. The resistance of the air.

If a projectile were acted on by the force of projection alone, it would (by the first law of motion) proceed in a straight line and pass over equal spaces in equal times. The force of gravity however causes the projectile to fall with a constantly accelerating velocity, so that, were it moving in vacuo, it would describe a curve instead of a straight line. This curve is a parabola.

But the resistance of the air, which, according to Professor Bashforth's experiments, varies approximately as the cube of the velocity,* the square of the diameter and inversely as the weight, further varies the form and renders the calculation of the elements of the trajectory a complicated mathematical problem. Most practical questions can however be comparatively easily worked out by means of Professor Bashforth's tables.

It is evident that (the resistance of the air varying as $\frac{d^2}{W}$) if two projectiles are of equal diameter and start with the same muzzle velocity, the heavier will lose its velocity more slowly and

* For velocities between 1100 and 1400 f. s., for higher velocities the resistance varies nearly as the square of the velocity, and for lower velocities at a higher power than the cube.

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range the further. Or if the two projectiles are of the same weight but of different diameters, the one with the smaller diameter will have the advantage.

This is well shown in the following range table, which gives a comparison between the shooting of a 12-pr. S.B. and a 12-pr. M.L.R. gun.

Gun.	Muzzle Velocity.	Range and Elevation.				
		1°	3°	5°	7°	9°
12-pr. S.B. . .	1,769	700	1,200	1,600	2,250	2,250
12-pr. R.M.L.	1,700	1,200	2,143	2,917	3,672	4,350

The remaining velocity of the two projectiles at 2000 yards would be

12-pr. S.B. 506 f. s.
12-pr. R.M.L. 977 f. s.

The momentum of the elongated projectile is thus nearly double that of the spherical one at 2000 yards, though it started at a slightly lower velocity.

If the weight of the elongated projectile were reduced from 12 to 9 lbs., its diameter and muzzle velocity remaining the same, its remaining velocity at 2000 yards would be 890 f. s., thus showing the disadvantage of reducing the weight of the projectile.

The weight of a rifled projectile can be increased,

1. By an increase of its length.
2. By an increase of its density.

The length of a shell is limited by the strength of its walls.

The pressure of the powder-gas is directed on the base of the shell. If the pressure therefore is high and the shell long, there will be a tendency in the walls to "set up" and premature explosions may occur. With the low charges employed in howitzers and consequently small pressures the length of the shell may be as much as four calibres without danger, but with service charges in guns it has been found in practice necessary to limit the length of the shells to from two and a half to three calibres.*

Shot are now only used in heavy or siege guns for battering purposes. A high velocity is necessary, and the weight and consequently length of the shot thus depend on the battering charge of the gun and the velocity desired to be attained. The shot in our service vary in length between $2\frac{1}{2}$ and $2\frac{1}{2}$ calibres.

If a shot and a shell of the same calibre were both of the same length, the shot from its greater weight would keep up its velocity the longer. In practice however shells are made of greater length than shot to compensate for their smaller density.

* Except 7-inch double shell, which is four calibres long nearly

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The density of a shot may be increased by making it of heavier material. A case shot therefore with iron balls would be a less powerful projectile than one of similar weight with lead balls.

The resistance of the air also varies according to the shape of the head of the projectile, a flat head meeting with most resistance and an ogival head (the form adopted in our service) the least.

Of other causes which affect the flight of rifled projectiles the following may be noticed :—

d. The rotation due to rifling.

e. The rotation of the earth.

d. A projectile fired from a rifled gun has a permanent deflection or "drift" in the direction of its rotation. This is chiefly due to the fall of the projectile by gravity causing the air to be more dense underneath it than at the sides and top, and thus forming a cushion on which it rolls.

The guns in our service have a right-handed twist, the projectiles therefore drift to the right, the amount of drift depending on the speed of rotation. Any cause therefore which diminishes the speed of rotation (such as unsuitable form of head, instability of axis, &c.) will also diminish the drift.

In service guns the drift is corrected by the insertion of the tangent scale at an angle to the left instead of vertically.

e. The rotation of the earth affects the lateral deviation of projectiles to a certain extent. The question has been investigated mathematically, and it is found that in the northern hemisphere the deviation is always to the right in whatever direction the gun may be fired.

3. VARIABLE FORCES ACTING ON A PROJECTILE.

All the above forces and causes of deviation will already have been ascertained and their effects noted and allowed for before a gun is issued for service, they will not therefore come under the cognizance of the practical gunner. There are however other causes of deviation which must be observed and corrected to ensure accurate shooting.

The following are the principal:

a. Variability of the effect of the charge due to,

1. Incorrect weighing.
2. Variation in the strength of the powder.
3. State of the atmosphere, especially as regards moisture.

b. Variability of space occupied by the cartridge in the bore.

c. Difference of level of wheels.

d. Force and direction of wind.

a. The only way to correct variations in the strength of powder, which are sometimes very great, is carefully to mix the

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powder before the cartridges are made up. This is not a very difficult matter with the small charges used in field guns and howitzers, and the better practice that will be obtained amply compensates for the time and trouble involved in the operation; extreme care in weighing out the charges (especially for howitzers) cannot be too strictly enforced.

A long continuance of wet weather will cause the cartridges (unless stored in magazines) to absorb a certain amount of moisture, which will cause a reduction in muzzle velocity and consequently in range. The contrary effect will take place in dry weather, especially in hot climates. As, however, from this cause all the cartridges in the limber boxes would be nearly equally affected, it is an easy matter to make the necessary correction by giving more or less elevation to the gun.

b. If the shell is not rammed home exactly to the same spot each round, the shooting will be injuriously affected. The greater the space occupied by the cartridge the less will be the range.

It is important, therefore, that the mark on his rammer always coincides exactly with the muzzle of the piece.

c. If the gun wheels (or trunnions) are not level when the gun is fired the shell will deflect towards the lowest side. It is difficult to ascertain any small difference of level by the eye. Guns on travelling carriages will, however, probably be fitted with a "deflector," a small pendulum hanging to the axletree, by means of which the difference of level can be read off. Rifled howitzers have cross planes cut on the top of the B coil and button, on which a quadrant can be placed. The rule for correction is to multiply the number of inches difference of level by the number of degrees of elevation at which the gun is to be fired for the number of minutes deflection necessary, or if a quadrant is employed,

$$\frac{\text{No. of minutes difference of level} \times \text{No. of degrees elevation}}{60}$$

for minutes of deflection.

In practice, if great accuracy is required, it will be found better to level the wheels approximately, if they are much out, than to lay off the target.

d. Wind has considerable effect on the deviation. According to its direction it may increase or reduce the range, or deviate the projectiles right or left. If gusty, and of great force, it is impossible to make any correction for it, and the shooting will be bad, especially at long ranges or with low charges.

If, however, the wind is fairly constant in direction and force the necessary corrections can be made on the tangent or deflection scale. No formula can be given for this correction as the force of the wind must be judged, no instrument for this purpose being available. A little practice will however enable a No. 1 of

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ordinary intelligence to obtain a very close approximation to the proper correction, and the second round would be corrected by the result of the first.

4. EFFECT OF PROJECTILES.

A. Common Shell.

Common shells may be used :—

1. To destroy the "personnel" and "matériel" of the enemy.
2. To destroy earthworks, buildings, &c.

1. In the first case the shell depends for its effect on the striking force of the splinters into which it bursts. A high velocity and a considerable number of good sized splinters are the principal requirements for this nature of fire.

To obtain the maximum effect from common shells against troops in the open they should be burst close up to or, if the troops are in column or other deep formation, on the head of the column. Against troops behind cover (field entrenchments, &c.) the crest of the parapet or other covering obstacle should be the point aimed at. Against guns, limbers, &c., the shells should not be made to burst short, but an endeavour be made to obtain direct hits.

Percussion fuzes should be used in all but very exceptional cases, such as when the ground in front of the enemy is very soft, and prevents the fuzes from acting or smothers the bursts, or if the troops fired at are in such a position that the splinters of shells burst on graze pass over their heads.

2. When employed for the destruction of earthworks, magazines, buildings, &c., the common shell depends for its effect on its striking velocity (and consequent penetration) combined with the explosive force of its bursting charge.

Several kinds of fire may be employed :—

- a. Direct fire from guns to destroy—
 1. Earthworks.
 2. Masonry.
 3. Ships.
- b. Indirect or curved fire from guns or howitzers to destroy—
 1. Earthworks, bombproofs, &c.
 2. Masonry.
- c. High-angle fire from howitzers and mortars to destroy—
 1. Earthworks, magazines, &c.
 2. Masonry (roofs of casemates, &c.).
 3. Ships' decks.

a. 1. In breaching a parapet by direct fire the upper part of it should be the point aimed at, and the point of impact then gradually

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lowered so as to cut down the parapet from the top. It has been found that shells bursting low down in a parapet do but little damage, they throw up a certain amount of earth which is apt to fall back again into its original place.

R.L. percussion fuzes should be used for this nature of fire whenever practicable. Pettman fuzes only act on direct impact; every shell that grazed short or on the top of the parapet would therefore be blind. R.L.P. fuzes on the other hand act on graze, shells bursting on the parapet (and to a certain extent those bursting short) would therefore be effective against the men and material behind it.

2. Direct fire at masonry is either for demolition or for breaching. In the former case the shells would be distributed over the whole or the greater part of the surface of the wall or building intended to be destroyed.

In the latter case, if circumstances permit, a regular breach may be made as follows: A horizontal cut, the width of the proposed breach, is formed at about one-third the height of the wall from the bottom, and when the wall has been cut through vertical cuts from the extremities of the horizontal cut to the top of the wall are made to bring it down. If the range is too great or the accuracy of the guns employed insufficient to form a regular breach as above described, the wall may be breached by demolition, but this involves a larger expenditure of ammunition.

At the siege of Soissons, in 1870, a practicable breach 27 yards wide at the top was made by demolition in 1,000 rounds from 15 centimetre (5.9-inch) guns, from a range of 1,804 yards. The wall breached was 4.1 feet thick at the top and 9.8 feet thick at the bottom, and inclined at an angle of 45 degrees to the line of fire.

It has been found by experiment that common shells when fired directly into masonry explode on impact, even when not fuzed. They would therefore as a rule be fired filled and plugged until the outer surface of the wall was destroyed, and there was risk of the shells penetrating into the earth in rear. Pettman or delayed action percussion fuzes would then be used.

3. Common shells when fired at wooden or iron unarmoured ships would be fuzed with Pettman G.S. fuzes.

The heavier natures of common shell are also effective at short ranges against ironclad ships of the "Warrior" class. The shell breaks up in passing through the armour and the bursting charge ignites.

b. 1. The accuracy obtainable by curved fire being, as a rule, less than that with direct fire, the angles of descent greater and the shells heavier, no attempt can be made to cut down the parapet from the top. The shells should, as far as possible, be pitched on to the exterior or superior slopes of the work, and burst by percussion fuzes (sensitive).

2. Breaching by indirect fire would, as a rule, be by demolition and not by the formation of regular cuts. Sensitive percussion fuzes would be used.

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If the conditions for accuracy are sufficiently favourable, a regular breach may be made, as was done at the siege of Strasbourg, in 1870. 15-centimetre guns, with a charge of 2.9 lbs. and elevation of $4^{\circ} 23'$ to $4^{\circ} 26'$, were employed at a range of 853 yards. The wall was 27 feet high, 5.45 feet thick at the top, and 12.3 feet at the bottom.

The horizontal cut was clean and regular at about one-third the height of the wall from the bottom. After the formation of the vertical cuts, the wall was thrown down in two large pieces.

A practicable breach was thus formed in 600 rounds.

c. 1. At angles of elevation sufficiently great to prevent the ricochet of the shells after impact (about 20° and upwards), the maximum effect at earthworks, magazines, &c., will be obtained by delaying the bursts of the shells till they have obtained their full penetration. For this purpose either delayed action percussion fuzes or time fuzes bored long so as to burst the shells from one to two seconds after impact, may be employed. If the elevation is less than 20° many of the shells will ricochet and their effect would be lost were the burst delayed. The best results will then be obtained by the use of ordinary percussion fuzes.

2. At Eastbourne in 1876 common shells, 355 lbs. in weight, fired from the 10-inch R.M.L. howitzer from a range of 3,000 yards, with a charge of 11 lbs. and elevation of about 32° , produced hardly any effect on the roofs of casemates (brick arches and iron girders with a concrete covering from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet thick). The maximum penetration obtained was 12 inches. With the 8-inch howitzer on the same occasion the effect, as might be expected, was less.

These results are confirmed by the German experience at the siege of Paris, where strong casemate arches, 2.5 feet thick, with an earth covering 2.6 feet thick, were found to be proof against 15 and 21-centimetre (5.9-inch and 8.27-inch) shells.

The only way to obtain increased penetration is to increase the elevation. The Germans found that the penetration of howitzer shells fired at elevations between 40° and 60° was nearly double that at 30° elevation. This has been verified by recent experiments at Shoeburyness.

B. Shrapnel Shell.

Shrapnel shells are used exclusively against the personnel of the enemy. They depend for their effect on the striking velocity of the balls and splinters disengaged from the shells on bursting. The higher the velocity the more effective the shell, because, not only is the angle of descent for a given range less and the space covered by the balls therefore greater, but the penetrative power of the balls is also increased.

The bursting charge of a shrapnel shell should not be more than sufficient to open it, or the balls will be dispersed to too great an extent. The cone of dispersion of our field shrapnel has been found to be about 8° at medium ranges. That is to

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say a front of 14 yards would be covered by a shell bursting 100 yards short, and so on in proportion.

Time fuzes are nearly exclusively used with shrapnel. With percussion fuzes, not only is the velocity of the shell reduced by the graze, but as it rises from the graze before bursting, the balls are thrown upwards and reach the ground with a greatly reduced velocity.

The principal circumstances that limit the effective range of shrapnel are—

1. The penetrative power of the balls.
2. The time of burning of the fuze.
3. The angle of descent of the shells on bursting.

1. We may take it for granted that a ball which will perforate or lodge in a 2-inch deal target would kill or disable a man.

There are but few data on the subject, but the following will suffice :—

The 7-pr. R.M.L. steel gun of 150 lbs. weight, fired with a charge of 6 oz. and time shrapnel, put a small proportion of balls through a row of 2-inch targets at 800 yards. The shells burst from 50 to 100 yards short. The velocity of the heavier balls on striking the target was therefore from 500 to 550 feet per second.

We will assume 500 feet per second to be the lowest effective striking velocity of shrapnel bullets.* The remaining velocity of the 9-pr. shrapnel at 4,000 yards is 626 f. s., and that of the 16-pr. at 5,000 yards is 617 f. s. As far then as the penetrative power of the balls is concerned, the shells will be effective at these ranges when burst within 100 yards of the objects if filled with 1-oz. balls, or within 75 yards of it if filled with $\frac{1}{2}$ -oz. balls. The heavier the shell the longer it will retain its velocity. Shrapnel from siege and heavy guns will therefore be effective at longer ranges than the above.

2. The limit of the 9-sec. fuze in the 16-pr. is 3,100 yards, and in the 9-pr. 2,900 yards. The 15-sec. fuze now introduced has increased the effective range of shrapnel from these guns to 4,200 and 3,800 yards respectively.

3. The angle of descent has considerable influence on the effect of shrapnel. If it is great the lower part of the cone strikes the ground at such an obtuse angle that ricochet is prevented, and the upper part of the cone covers but little ground before the graze of the balls. At 2,000 yards the angle of descent of the 16-pr. shell is 6° , and that of the 9-pr. $6^{\circ} 37'$, the lower part of the cone would therefore reach the ground at 10° and $10^{\circ} 37'$ respectively, and the velocity of the balls would be greatly reduced after ricochet. As the range and angle of descent increase the retarding force of the graze also increases, till at 4,000 yards the angle of descent of the lower part of the cone would be about 20° , and the balls would hardly ricochet at all.

* Major Barlow, from some experiments he carried out in 1875, came to the conclusion that a striking velocity of from 360 to 400 f. s., would be sufficient to render the heavier shrapnel balls effective.

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It is thus evident that, with our present field guns, an effective shrapnel fire is not to be expected at ranges beyond 4,000 yards. Long before this limit is reached it becomes more and more difficult to make really good practice, because the longer the range the closer to the target should the shells be burst, whilst at the same time the difficulty of observation increases. The fuzes also cannot be adjusted within sufficiently close limits.

The following tables are extracted from the result of shrapnel practice.

Table I. shows how much more difficult is the use of percussion as compared with time shrapnel as far as mere accuracy of shooting is concerned.

Table II. gives the best distances and heights above plane to burst time shrapnel.

Table III. gives the value of each graduation of the 5-sec. and 9-sec. fuzes.

TABLE I.

Percussion shrapnel.				Time shrapnel.			
Ranges.	Burst short.			Ranges.	Burst short.		
	Effective.	Good.	Bad.		Effective.	Good.	Bad.
yds.				yds.			
1,000	from 20 to 100	40	over 170	1,000	from 10 to 150	100	over 250
1,300	" 20 to 70	25	" 145	1,300	" 10 to 120	80	" 220
1,600	" 15 to 50	20	" 100	1,600	" 10 to 110	80	" 190
2,000	" 10 to 25	12	" 50	2,000	" 10 to 100	80	" 170
2,300	" 5 to 15	10	" 30	2,300	" 10 to 90	60	" 150
2,600	" 5 to 12	9	" 20	2,600	" 10 to 85	60	" 135
3,000	" 5 to 10	7	" 15	3,000	" 10 to 80	60	" 120

TABLE II.

16-pr.				9-pr.		
Burst short.	Range.	Angle of descent.	Height.	Burst short.	Angle of descent.	Height.
yds.	yds.	° /	ft.	yds.	° /	ft.
100	1,000	2 20	12·0	80	2 29	10·4
80	1,200	3 0	12·6	60	3 10	9·9
"	1,400	3 40	15·3	"	3 54	12·2
"	1,600	4 25	18·5	"	4 43	14·8
"	1,800	5 12	21·9	"	5 38	17·9
"	2,000	6 0	25·0	"	6 37	21·0
60	2,200	6 57	21·6	40	7 39	16·0
"	2,400	7 47	24·5	"	8 46	18·5
"	2,600	8 45	27·7	"	9 54	20·9
"	2,800	9 45	30·8	"	11 10	23·6
"	3,000	10 46	34·2	"	12 34	26·5
50	3,200	11 47	31·2	30	13 53	22·2
"	3,400	12 46	33·9	"	15 22	24·6
"	3,600	13 51	36·7	"	17 6	27·6
"	3,800	14 52	39·7	"	18 50	30·7

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TABLE III.

Value of each graduation of the time fuze in 16-pr. gun.

5-sec. fuzes.			9-sec. fuzes, beginning at 1 in.		
Tenths of fuze.	Range.	Difference due to $\frac{1}{2}$ tenth.	Tenths.	Range.	Difference due to 1 tenth.
	yds.			yds.	
1·0	200	—	10	1,725	—
1·5	295	95	11	1,875	150
2·0	390	95	12	2,020	145
2·5	485	90	13	2,165	145
3·0	575	90	14	2,305	140
3·5	665	90	15	2,445	140
4·0	755	90	16	2,580	135
4·5	840	85	17	2,715	135
5·0	925	85	18	2,845	135
5·5	1,010	85	19	2,975	130
6·0	1,095	85	20	3,100	125
6·5	1,175	80			
7·0	1,255	80			
7·5	1,335	80			
8·0	1,415	80			
8·5	1,495	80			
9·0	1,575	80			
9·5	1,650	75			
10·0	1,725	75			

C. Battering Projectiles.

Battering projectiles are used for the penetration of iron armour, and to a limited extent for breaching purposes. Those in our service (Palliser) are made of cast-iron, the heads being chilled and the bodies cast in sand.

On striking an iron plate the body of a Palliser projectile nearly invariably breaks up, but the head retains its form, though it is sometimes cracked to a greater or less extent.

If two iron plates are placed one behind the other, but separated by an air space of a few feet, the projectile is broken up by the front plate and strikes the back one in a state of disintegration with hardly any penetrative force, although its *vis viva* might have been sufficient to penetrate the two plates if they had been touching each other or the same thickness of metal if combined in one plate.

Hard steel plates break up the projectiles and greatly reduce their penetration, but the plates themselves are nearly always cracked or broken by the blow. Soft steel plates give but little more resistance than wrought iron.

The most promising material for armour plates yet tried is hard steel welded to a backing of wrought iron. The hard steel breaks up the projectiles and, though it cracks, is held together by the wrought iron backing, a 9-in. plate made on this principle gave a resistance about equal to a wrought iron 12-in. plate.

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It has been found that a thin wrought iron plate placed in front of a steel one diminishes the resistance of the latter. The reason apparently being that the wrought iron plate holds the point of the shell together and prevents its being broken by the steel plate.

The above remarks apply to impact on plates whose face is at right angles to the line of fire.

The greater the angle at which a Palliser projectile strikes a plate the less is its penetrative power. But if the angle is not sharp enough to prevent the point from touching the plate, the latter generally bites and the shell turns until its axis is approximately at right angles to the face of the plate into which it then penetrates.

The following table gives the perforating power of Palliser shells of various calibres into unbacked wrought iron plates:—

Calibre of Gun and Charge.	Thickness of Plate in inches perforated at yards.												
	5	6	7	8	9	10	11	12	13	14	15	16	20
7" (7 tons) 30 lbs.	3000	1800	1000	500	0								
9" (12 ") 50 "	3600	2300	1400	800	200						
10" (18 ") 70 "	4200	2600	1700	900	300				
11" (25 ") 85 "	4400	2800	1800	1000	400			
12" (25 ") 85 "	"	"	"	"	"			
13" (35 ") 110 "	3400	2200	1400	800	0	
13.5" (28 ") 160 "	4000	3000	2300	100

The 16-inch M.L.R. gun of 80 tons, with a charge of 425 lbs., will perforate a 30-inch plate at 100 yards, and a 24-inch plate at 2,800 yards.

D. Case Shot.

Case shot from field and siege guns is used at close ranges against troops. It may be considered effective up to 600 yards according to the nature of the ground. Hard even ground is most favourable for it.

Case shot from heavy guns would generally be used against boats, &c. It may be considered effective up to nearly 1,000 yards.

E. Star Shells.

Star shells are fired from the 6.3-inch and 8-inch howitzers and the 7-pr. gun for the purpose of lighting up the ground in front and discovering the enemy's movements, ascertaining if he is repairing or throwing up batteries, &c.

The maximum effective range of the shells from the howitzers is about 1,200 yards; that of the 7-pr. shells about half the distance.

The shells should be burst in the air so as to release the stars from 100 to 200 feet above the ground and to windward and in rear of the object to be illuminated.

The stars, while falling, illuminate a considerable extent of

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ground, but are most effective while burning on the ground, in rear, and slightly to windward of the object to be lighted up, so that either the stars themselves, or the smoke from them, form a background to it.

They are nearly useless if they fall in front or to leeward of the object.

VI.—ARTILLERY FIRE.

1. FIELD ARTILLERY.

The projectiles of field artillery are common shells, shrapnel, and case shot, its targets, the enemy's troops, guns, &c., either in the open or more or less covered, and also fieldworks, entrenchments, and buildings. The two first would, as a rule, be attacked by shrapnel, the three last by common shell fire. As however but little effect can be produced on earthworks by common shells from field guns, they would generally be employed more with a view to disturb the troops covered by the earthworks than for the destruction of the earthworks themselves.

A. Shrapnel Shell.

Shrapnel is *par excellence* the field artillery projectile. The chief points that require attention in order to obtain the best results with it may be briefly stated as follows:—

a. The service of the gun must be correctly performed. This involves a careful instruction of the gun detachment, especially in the following points:—

1. Laying (see page 336).
2. Loading, more particularly the uniform ramming home of the charge (see page 22).
3. Boring of fuzes (see page 62).

b. The elevation of the range (measured or estimated) must be correctly ascertained. This will seldom agree exactly with that given in the range table, as some of the disturbing causes mentioned in pages 21 and 22 generally come into play.

The necessary deflection must also be given to correct difference of level of wheels, wind, &c.

c. The length of fuze must be ascertained. It will always be shorter than that given in the range table for the range, because,

1. The length of the fuze there given is for common shell, *i.e.*, for a burst at the target instead of from 50 to 100 yards short of it (see table page 32).

2. The time of burning of a fuze increases with its age. Fuzes that have been stored in hot climates sometimes burn irregularly, giving premature and blind shells.

3. The time of burning increases as the barometric pressure diminishes. Every diminution of pressure by one inch (equivalent to 1,000 feet in height) increases the time of burning of a fuze

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by $\frac{1}{30}$. The fuze tables are based upon practice at Shoeburyness, approximately the sea level, but batteries will often come into action at more than 1,000 feet above this level, and a sensible increase in the time of burning of the fuzes will then occur.

d. The result of each round must be carefully observed. It will hardly ever be possible to estimate the actual distance of the burst of a shell from the target. The only point there can be any certainty about, is whether a round burst short of or beyond the target, and even this cannot always be done unless the bursts are comparatively low.

The first rounds fired on coming into action should therefore, as a rule, be fired slowly and deliberately, and corrections made as follows, two rounds at least being always fired with the same elevation and fuze:—

a. If the shells are observed to burst short, increase the length of fuze by a graduation at a time till a shell is observed to burst over. Then reduce the length of fuze by one graduation.

If the shells burst over, reduce the length of fuze by a graduation at a time until one bursts short; then go on with this length of fuze.

b. If the shells burst so high as to render it difficult to decide whether they are bursting short or over, reduce the elevation and then proceed as in a.

c. If a shell grazes short of the target before bursting, increase the elevation and proceed as in a.

By this method we may be certain of getting the elevation and length of fuze as nearly as possible correctly.

Example:—

16-pr. Gun at 2,200 Yards.

Number of round.	Length of fuze.	Observed position of burst.
1	13	over (+)
2	"	"
3	12	short (—)
4	"	" "

The distance between the bursts of the fuzes bored at 12 and 13, should be (see table, page 33) about 145 yards. The two first rounds both being over, shows that their mean burst must have been some little distance in rear of the target, and 12 fuze would therefore probably bring the burst within the effective limit of the shrapnel at this range (90 yards, see table, page 32). If, however, the mean burst of the two first rounds happened to have been close in rear of the target, that from 12 fuze would consequently be about 140 yards in front of it and therefore beyond the effective limit. This length of fuze must nevertheless be retained, as the Boxer 9-sec. fuze does not admit of finer adjustment.*

* The 15-sec. fuze being graduated to quarter seconds can be bored to double the fineness of the 9-sec. fuze. In the above example the difference between two adjacent graduations would be about 72 yards.

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B. Common Shell.

It is advisable, when circumstances permit, to ascertain the correct elevation by a fire of common shell with percussion fuzes. The bursts of the common shell are more easily observed than those of the shrapnel, and less ammunition and time will therefore be expended in the process. The following will be found a quick method of ascertaining the correct elevation:—

Begin with the elevation (yard scale) for the estimated or measured range. If the shell falls short (or over) increase (or reduce) the elevation by 100 yards at a time, till a shell falls over (or under). Then reduce (or increase) the last elevation by 50 yards and fire a few rounds. If another correction is required, increase or reduce the elevation by 25 yards.

If half the number of rounds fired, with any given elevation, fall short, it shows that the mean point of impact of the series is at the foot of the target.

Example:—

16-pr. at 2,200 Yards.

No. 1 Gun.		No. 2 Gun.		No. 3 Gun.		No. 4 Gun.		No. 5 Gun.		No. 6 Gun.	
Elevation.	Short or over.	Elevation.	Short or over.	Elevation.	Short or over.	Elevation.	Short or over.	Elevation.	Short or over.	Elevation.	Short or over.
2,200	+	2,100	—	2,150	—	2,150	—	2,150	—	2,175	+
2,175	+	2,175	—	2,175	+	2,175	+	2,175	—	2,175	—

Of seven rounds fired with an elevation of 2,175 yards four were over and three short. The elevation is therefore approximately correct.

C. Firing at Moving Objects.

When a battery has taken up a position, it is always advisable to ascertain the ranges of any conspicuous natural objects in its front, in order to be able to open an effective fire on any of the enemy's troops as soon as they pass close to these objects. If this is not possible and there is no means of ascertaining the range of the moving target, except by firing, then:—

1. If the target is moving towards the battery, keep up a slow fire with an elevation less than that necessary for the original range of the target until a round is observed to hit or to be over. Then a rapid fire for about half-a-dozen rounds (or a salvo). Then reduce the elevation by 200 yards and proceed as before, and so on.

2. If the target is moving away from the battery, begin as before, but with more elevation than necessary until there is a round short or a hit, then rapid fire, then increase the elevation by 200 yards, and so on.

3. If the target is moving across the front of the battery, lay on the head of the column, or other body of troops, with the elevation for the range.

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D. Practice with Reduced Charges.

Practice with reduced charges from field guns is of very doubtful value:

1. Unless the charges are weighed with extreme accuracy and the powder well mixed, even moderately good practice is not to be expected.

2. The shells travelling with low velocities are more affected by extraneous causes than shells fired with service charges. The variations in the ranges will therefore be very great from day to day and range tables but little to be depended upon.

3. The objects fired at are nearly always concealed from view. The difficulty of obtaining reliable observations of the result of the practice is therefore very great, and a large amount of ammunition will often be thrown away without producing any effect.

4. The adoption of this kind of fire necessitates the carrying of scales and weights, extra cartridge bags, and either special percussion fuzes or gun cotton priming for the time fuzes.

The following practice carried out at Shoeburyness in 1878 shows that under most circumstances better results may be expected from shrapnel shell with full charges than from common shell with reduced charges. (Shrapnel being dependent for its efficiency on the velocity of the balls when released from the shell cannot be fired with reduced charges with any advantage.)

1. Targets and dummies arranged in rows on the sloping beach, the sea wall forming a parapet. The foot of the rear row of targets was 112 yards from the crest of the sea wall, and 13 feet 8 inches below it.

16-pr. R.M.L. Guns at a range of 1,030 yards.

Shell and Fuze.	Charge	Elevation.	Number of rounds fired.	Number of hits.		Hits per round.
				Targets.	Dummies.	
Common shell } R.L. perc. fuze }	1 lb. 8 oz.	2° 30' to 3° 35'	8	..	2	0.25
Common shell } time fuze .. }	0 lb. 8 oz.	9° to 13½°	9	2	3	0.56
Shrapnel time } fuze .. }	3 lbs. 0 oz.	1° 40' to 1° 50'	3	98	13	37.00

2. Targets and dummies arranged immediately in rear of a parapet 7 feet high.

16-pr. R.M.L. Gun at a range of 1,000 yards.

Shell and Fuze.	Charge.	Elevation.	Number of rounds fired.	Number of hits.		Hits per round.
				Targets.	Dummies.	
Common shell } R.L. perc. fuze }	1 lb. 8 oz.	3° 18' to 3° 25'	10	1	5	0.6
Common shell } time fuze .. }	0 lb. 8 oz.	12° 30' to 13° 45'	10	Nil.
Shrapnel time } fuze .. }	3 lbs. 0 oz.	1° 40' to 2° 40'	10	1	11	1.2

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2. SIEGE ARTILLERY.

The principal projectile of the siege artillery is the common shell. The three classes of ordnance guns, howitzers and mortars, are represented, and the three natures of fire: direct, indirect, and high-angle, used.

The rules given for field artillery fire are applicable to siege guns, and further details are given in Part III., Sect. IX.

3. GARRISON AND COAST ARTILLERY.

Guns on the land front of fortresses are of approximately the same calibres and have much the same duties to perform as siege guns.

The heavier natures of guns (7-inch R.M.L. and upwards) are almost exclusively for coast defence.

Ships and boats will be their principal targets, and they will nearly always be in motion.

Except in narrow channels, where the hostile ships are confined to certain definite routes, the range of which from the various guns is accurately known, some system of range-finding is absolutely necessary.

A ship is a large target, and as far as direction is concerned there is no difficulty in hitting it, but a small error in elevation is quite sufficient to cause the shell to fall short or over.

For instance, supposing the target to be a ship at 2,000 yards range, the gun a 10-inch R.M.L. with battering charge of 70 lbs. P powder and Palliser shell. The angle of descent at this range is about 4° . A shell therefore falling 50 yards over would just touch the top of an object $10\frac{1}{2}$ feet high. If then the ship's side is 10 feet out of the water, and the point aimed at the centre of the side, an error of 25 yards in elevation would be sufficient to cause the shell to pass over or graze short of the ship's side. (25 yards = about 3 minutes' elevation, and at 2,000 yards 3 minutes = 5 feet in vertical height.)

The longer the range the greater is the angle of descent, and the smaller therefore the permissible error. At 3,500 yards, angle of descent about 8° , an error of less than 15 yards in elevation would be sufficient to cause a miss.

The principal projectile of the coast artillery is the Palliser shell. Common shells with Pettman G.S. fuzes would only be fired at wooden or iron unarmoured ships. Shrapnel shells with time fuzes at boats, at the ports of broadside ships, at the decks of ships with barbette guns, or at the tops of ships armed with Gatling guns.

PART II.—INSTRUCTION IN AMMUNITION.

A MOST necessary part of instruction is a thorough explanation of all ammunition used in the service, its distinguishing marks, preparation and various uses.

Little time need be occupied in describing manufacturing details.

Specimens of the ammunition should be placed before the squads during the explanation.

Gunpowder.

Gunpowder used in the service of ordnance is classified as follows :—

[This table gives the *serviceable* classes of powder. It is to be noted that the term "service" is to be applied only to powder used for firing projectiles.]

Class.	Designation.	Description.
I.	Service	1. All new powder. 2. All returned powder (including cannon cartridges) which on examination may be found uninjured.
II.	Blank	1. Powder from broken-up cannon cartridges, unless specially placed in Class I. 2. Powder from broken-up S.A. Ammunition (M.L. only). 3. Service powder found dusty or broken in the grain at periodical inspections, or on return; except such as, being only dusty, is firm enough in grain to be redusted for service.
III.	Shell	Powder found too dusty and broken in grain for Class II.

The following list shows the purposes for which powders of the several descriptions are to be used; and demands and issues will be regulated in accordance therewith:—

*P*². For battering charge of 12·5-inch R.M.L. gun.

P. For the *battering* charges of all rifled guns of 7-inch calibre and upwards, except 12·5-inch, and for all full charges of 40 lbs. and upwards. When no *P*. powder is available, *R.L.G.* will be used.

Ammunition.

Service R.L.G. For full charges to the Royal Navy of 9, 8, and 7-inch R.M.L. guns, for battering and full charges of certain guns when *P.* powder is not available for ordnance for siege train, except 7-pr., and for R.M.L. field artillery, *i.e.*, for 9, 16, and 25-pr. guns.

Service L.G. For all full charges with R.M.L. land service garrison guns under 10-inch, and S.B. ordnance; for R.M.L. sea service, 80-prs. and under, and R.B.L. guns. The 7-pr. R.M.L. gun, however, is an exception, for which F.G. or R.F.G. is used for land and sea service.

Service R.F.G. For rifled small arms of every description except Martini-Henry and pistols, for 7-pr. R.M.L. guns, and for the bursting charges of shrapnel shells when the stock of F.G. is exhausted.

Service R.F.G.². For Martini-Henry rifle, carbine, and for Gatling guns.

Service F.G. For 7-pr. R.M.L. guns, for all smooth-bore small arms and for the bursting charges of shrapnel shells.

Service Pistol. For Colt's and Adams' cartridges, and for bursting charges of shrapnel shells made, like F.G. powder, with common (willow and alder) charcoal; very little of this pistol powder remains.

Service Adams' Pistol. For the cartridges for Adams' revolver. Obtained from the siftings of R.F.G.² powder §3222.

Blank, or Exercise, R.L.G. and L.G. For blank charges (including the reduced charges of 9, 8, and 7-inch R.M.L. guns when issued to the Royal Navy) of all descriptions of rifled and smooth-bored ordnance.

Blank, or Exercise, R.F.G., R.F.G.², and F.G. For blank small-arm cartridges of every description. These powders may, if it be considered advisable, be used for blank charges for ordnance when there is a surplus store.

Shell Powder. L.G. for the bursting charges of all shells, rifle, or smooth-bore, except shrapnel (see above), and 6, 9, 12, and 20-pr. segment shells, for which F.G. is to be used, or R.F.G. when the stock of F.G. is exhausted. F.G. or L.G. in Class II. may be taken if no F.G. or L.G. in Class III. be available, and Service F.G. or L.G. if no blank F.G. or L.G. be available.

Service powder will never be issued for *blank* or *exercise* cartridges when any powder classed under the latter head is available. This rule is intended to apply strictly to the non-issue of Service R.L.G., R.F.G., and R.F.G.² powders for blank charges. Exercise powder will not be issued for filling shells when shell powder is available.

Ammunition.

Loose powder is packed in wooden barrels, hooped with copper and ash hoops. There are three sizes, "*whole*," "*half*," and "*quarter*." The "*whole*" barrel will contain 125 lbs. of "P" and "P²" powder and 100 lbs. of all other natures.

Cartridges.

Service Cartridges.

The bags of all R.M.L. service cartridges are now made of silk cloth, with the exception of those for 4-oz. charges for the 7-pr., which are of red shalloon. The existing store of serge bags are to be used up for charges under 85 lbs. For R.B.L. and S.B. they are of serge.

The nature of gun and charge and description of powder are marked on the outside of each cartridge bag.

Heavy rifled guns from 7-inch R.M.L. upwards have two service charges, "*battering*" and "*full*." The former is intended for use with Palliser projectiles, the latter with all other natures.

All R.M.L. cartridges of 20 lbs. and upwards, have broad becketts over their choked ends to facilitate withdrawal from cases.

The cartridges for heavy R.M.L. guns are stored in zinc cylinders, which are stamped with the nature of gun and charge for which intended. Cylinders are stacked for 11-inch and upwards 3 deep, 10-inch and 9-inch 4 deep, and 7-inch 5 deep.

Filled cartridges for field and siege ordnance are packed in brown paper covers to protect them from wearing out, and from damp, and to prevent powder dust from getting into the limber boxes.

B.L. cartridges have lubricators choked inside the cartridges of 40-pr. and lower natures. In the 7-inch a wooden socket is choked into the cartridge, into which the lubricator is screwed outside. Lubricators distribute a mixture of linseed oil and tallow over the bore to prevent fouling and leading.

The 20-pr., 40-pr., and 7-inch cartridges have a varnished paper cylinder placed in the centre, in order to bring them up to the length of the powder chamber, the charge for which these guns were originally constructed having been reduced.

Saluting or Exercising Cartridges.

Saluting or exercising cartridges are made of silk cloth for R.M.L. and S.B. ordnance.

Those for the R.B.L. guns are of serge; they have no lubricators, or paper cylinders.

Instructions for Filling Cartridges.

Service and exercising cartridges are all to be filled and choked in the ordinary manner, the serge cartridges with worsted (except

Ammunition.

R.B.L. service, which are choked with twine), and the silk cloth cartridges with silk twist—the heavier natures with the twist doubled. In choking cartridges which have becketts attached, the choke is first to be formed and temporarily secured with the becket drawn tightly in on both sides, and the choke is then to be completed, stitching through the becket, which should form a loop about $3\frac{1}{2}$ inches in length over it.

The cartridges are to be made up to their proper lengths and diameters, by means of the hoops, which should be drawn tight so as to make a firm cartridge.

With braid hoops the knots are to be tied “over” the loop with a single bend, so as to ensure a secure fastening.

Cartridges which are intended for either pebble or R.L.G. powder are, when filled with the R.L.G., to have the hoops drawn in below the regulated diameter, so as to keep them to their proper length; projecting ribs, will, however, be found in those parts where the hoops are in the interior of the cartridge, these ribs remaining at about the regulated diameter, for the same reason—that is, to keep them to their proper length; the braid is to be drawn in with all cartridges whenever the powder is of a denser description than usual.

The 12.5-inch 80-lb. cartridges (of which two are used for the battering charge of 160 lb.) are made up with a stick in the centre, one end of the stick is attached to the inside of the bottom of the cartridge, and the other end is fixed in the choke; the stick being of a certain length ensures, when the projectile is rammed home, an uniform amount of air space for the charge. This arrangement will, probably, in future, be carried out in the cartridges for other natures of heavy ordnance.

Finished Cartridges.

All cartridges must be very carefully examined, and gauged as to length and diameter, previous to packing.

Drill Cartridges.

M.L. drill cartridges are hollow blocks of wood covered with raw hide, and are issued for drill purposes for almost all natures of guns. They are marked like the service cartridge.

B.L. Drill Cartridges.

Are made of a wood cylinder covered with felt and placed in a leather case, the base of the cartridge is shod with copper, and they have dummy lubricators, the detached lubricators having gun-metal stalks screwing into gun-metal sockets in the cartridge. The cartridge is marked in black same as the service cartridge, viz., with the nature of gun and weight of charge.

Ammunition.

METAL-LINED CASES.

Metal-lined cases are of three sizes,—whole, half, and quarter; they are rectangular cases of deal, the corners of oak, and the cleats of ash, lined with tinned copper.

A square lid opens on hinges on top of the case; it is screwed down by two gun-metal bolts by means of a gun-metal key; this lid covers a circular opening which is closed by a bung of tinned copper; the bung is luted into its place when the case is full.

The whole size will take all S.B. cartridges, and rifle cartridges up to 9 inches inclusive, except those made up with "P." powder; the two smaller sizes are generally used by the navy for small combustible stores and blank S.A. cartridges.

Metal-lined cases are to be preferred where injury from damp is to be apprehended.

For contents vide table at page 65.

ZINC CYLINDERS

Are used in the L.S. to contain the cartridges of the Woolwich guns. Each cylinder holds one cartridge; the 7-inch, Mark II., will hold two 14-lb. charges, or one battering charge. They not only act as cases in the magazine, but also serve to bring the cartridge up to the gun. The 12·5-inch, the 12-inch, or 11-inch are not to be stacked more than three deep, the 10-inch and 9-inch four deep, the 7-inch five deep.

They are painted stone colour, and marked with the nature of gun and nature and weight of charge.

Projectiles for S.B. Ordnance.

Projectiles for smooth-bored ordnance may be classed as follows:—

Shot..	..	..	{ Solid. Case. Grape. Sand.
Shells	..	..	{ Common. Mortar. Shrapnel. Hand grenade.
Miscellaneous	..	..	{ Carcasses. Ground light balls. Parachute light balls. Smoke balls.

SHOT.

Solid.

Wooden bottoms are riveted to solid shot when intended for use with guns of position or bronze guns. All S.B. solid shot are painted black.

Ammunition.

Case.

There are three classes:—1. Iron case with iron ends and iron handles. 2. Tin case with iron bottom and rope handles. 3. Tin case with wooden bottom. They consist of metal cylinders filled with sand shot of different sizes, according to the calibre. Case shot are fired from all natures of guns, carronades, and howitzers, and are used against troops or boats. The effective range is not much more than 350 yards.

Grape.

Caffin's pattern consists of four circular iron plates, between which three tiers of sand shot are arranged, a wrought iron spindle passing through the centre of the plates, and a nut which screws on to the head of the spindle binding the shot and plates together.

Grape shot for carronades and for 10-inch S.B. gun are made up like case shot.

Grape shot are only fired from cast-iron guns and carronades. They are used under the same circumstances as case shot, but owing to the greater weight of their balls, they have a longer effective range.

Sand.

Are cast iron shot of various sizes from $1\frac{1}{2}$ oz. to 4 lbs., chiefly used for making up case and grape, and shrapnel shells 7-inch R.M.L. and upwards.

SHELLS.**Common*

Are fitted with wooden bottoms. Their fuze holes are of the common gauge, and tapped throughout to take Pettman's L.S. percussion fuze and common wood time fuze.

Common shells are used against matériel, troops behind cover, wooden ships, buildings, &c.

Mortar.

Mortar shells have no wooden bottom attached. The 10-inch and 13-inch are fitted with *lewis holes* (formerly *lugs*), by which they may be lifted. The fuze hole is not countersunk, and is larger than that of common shells, so as to take the long fuze necessary on account of their time of flight. The fuze hole of the 8-inch mortar shell is somewhat smaller than that of the 10-inch and 13-inch, to admit of the fuze being set home.

For the $5\frac{1}{2}$ -inch and $4\frac{3}{4}$ -inch mortars, 24-pr. and 12-pr. common shell without wooden bottoms are used.

* For directions for filling shells *vide* page 57.

Ammunition.

Shrapnel.

The diaphragm pattern is the only one that need be noticed. It consists of a thin cast iron shell, weakened internally by four grooves, and filled with lead bullets. The bursting charge, which is just sufficient to open the shell and release the bullets, is separated from them by a wrought-iron diaphragm.

Shrapnel shells are used against troops in the open at distances beyond case shot range. It should burst from 50 to 20 yards in front of the object.

HAND GRENADES

Are used chiefly for the defence of places against assault, being thrown among the storming parties in the ditch. They are useful in the defence of houses. They can be thrown by hand about 20 or 30 yards. They are of two sizes, 6 pr and 3 pr.

CARCASSES

Are cast iron spherical shells with three vents or fire holes in their upper hemisphere. They are filled with a highly combustible composition, which is lighted by the flash of the discharge, and burns from 3 to 12 minutes, according to the calibre,

They can be fired from S.B. guns from 12-pr. upwards (in which case they should have wooden bottoms attached), and from mortars, from 13-inch S.S. mortars and 10-inch gun, charges not to exceed 16 lbs. and 8 lbs.

The vents are plugged with brown paper, and covered with kit plaster, which must be removed before loading.

Carcasses are used for incendiary purposes.

LIGHT BALLS.

Ground

Are oblong projectiles about $1\frac{1}{2}$ calibres in length. They consist of an iron skeleton frame, partially covered with canvas, filled with an inflammable composition, and woolded over the cylindrical part with cord or twine, vents being provided at the upper end for the composition to burn out of.

They burn from 9 to 16 minutes, according to the calibre, and are fired from mortars with reduced charges.

They are intended for use at night to discover an enemy's working parties, &c.

Parachute

Are shells formed of two hemispheres of tinned iron soldered and riveted together. A tin cup, filled with a bright burning composition and attached to a large calico parachute, is packed inside this shell, which contains a small bursting charge.

(A. M.)

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Ammunition.

Parachute light balls are fired from mortars only. Special time fuzes are used with them. They should be bored to such a length as to open the shell either at the highest point of its trajectory or soon afterwards. The bursting of the shell lights the composition and releases the parachute, which expands and floats in the air, descending gradually. The composition burns from one to three minutes, according to the calibre—10 inches, 3 minutes; 8 inches, $1\frac{3}{4}$ minutes; $5\frac{1}{2}$ inches, 1 minute.

The parachute light possesses many advantages over the ground light, but is much affected by the wind.

SMOKE BALLS.

Consist of a paper shell, having one vent, and filled with a composition that evolves a large quantity of smoke in burning. Time, 1 to 8 minutes.

Their chief use is as signals, but they might be thrown into mines or other confined spaces to annoy an enemy.

They are fired from 13-inch, 10-inch, 8-inch, $5\frac{1}{2}$ -inch, and $4\frac{3}{8}$ -inch mortars.

Projectiles for Rifled Guns.

A projectile from a rifled gun is compelled to rotate on its longer axis. Its deviation, being constant, can be easily corrected.

This rotation is obtained by means of spiral grooves cut in the bore of the gun.

The R.B.L. guns have a number of grooves, from 32 in the 6-pr. to 76 in the 7-inch with a uniform spiral. The projectiles are lead-coated and somewhat larger in diameter than the bore across the lands. When the gun is fired, the lead is forced into the grooves, and the rotation thus given to the projectile.

The R.M.L. guns have fewer but broader and deeper grooves from 3 in the 7-pr. to 9 in the 12.5-inch gun. The projectiles are fitted with studs of a softer metal, which "*take*" the grooves, and thus impart the necessary rotation.

R.M.L. guns, up to the 7-inch inclusive, are rifled with a uniform spiral; and the studs, of which there are two rings on the projectile (except 64-pr., which have three), are all of the same size.*

R.M.L. guns above the 7-inch are rifled with an increasing spiral, and the studs on the projectiles are of different sizes, the front studs being made of such dimensions that they touch the *loading* edges of the grooves when *home*, and the *driving* edges when at or near the muzzle. The theory on the subject is that the rotation is given entirely by the rear ring of studs, the front ring only serving to steady the projectile on its exit from the bore.

* The 80-pr. is an exception in which the front stud is smaller in order to lessen the strain on the shell when pressing in the studs, in course of manufacture.

Ammunition.

The common shell for the 6·3-inch howitzer has no studs, rotation being secured by a gas-check expanded into the shallow polygroove rifling.

Projectiles for rifled guns may be classed as follows:—

Shot	..	..	{ Solid. Palliser. Case.
			{ Common. Double. Battering.
Shells	..	..	{ Palliser. Shrapnel. Segment. Star.

SHOT.

Solid.

Are retained with the following B.L. guns:—6-pr., 9-pr., 12-pr., 20-pr., 40-pr., for practice only.

Palliser.

The body of the shot is cast in sand, the head alone being chilled. They may be distinguished by their heads, which are pointed, and are painted black. They have a large core, closed at the base by a gun metal screw plug. They can therefore be used as shells if necessary, their powder capacity varying from 1½ lbs. in the 7-inch to 7¼ lbs. in the 12-inch.

Palliser shot are fired with battering charges from all natures of heavy R.M.L. guns from 7 inches upwards (except the 11-inch, 12-inch (35-ton), and 12·5-inch), and are intended for penetration.

Case.

Case shot for rifled field guns consists of tin cylinders with tin or iron ends containing *mixed metal* balls of 16½ to the pound, their interstices being filled in with a mixture of sand and clay. The sides of the case are strengthened and the grooves of the gun protected by three longitudinal segments of sheet iron, laid in loose and forming an internal cylinder, a loose disc is also laid inside on the base of the cylinder. The number of balls varies according to the calibre, from 70 in the 7-pr. to 176 in the 16-pr., 16½ to a pound.

The 9-pr., 12-pr., and 20-pr. B.L. case shot have three lead studs, placed at equal distances round the base, to prevent the shot from being rammed too far up the bore of the gun.

The 6-pr. and 40-pr. B.L. case shot have two rings of studs, and the 7-inch (which can be used either in M.L. or B.L. guns) three large studs.

(A. M.)

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Ammunition.

The case shot for 9-inch R.M.L., and all heavier guns, are made of sheet iron, 40-pr. and 7-in R.B.L., and 64-pr. R.M.L. and upwards are filled with 8 oz. sand shot (from 35 in the 40-pr. to 834 in the 12·5-inch).

Case shot for 25-pr. to 7-inch guns have one iron handle on the top, those for 9-inch guns and upwards have two handles. In loading the handle should be towards the muzzle.

The limit of the effective range of case shot from rifled field guns is about 400 yards, that of case shot from heavy guns up to from 600 to 1,000 yards, according to the calibre and the nature of ground fired over.

SHELLS.

Common

Are used with all natures of R.M.L. and R.B.L. guns, except the 6-pr. B.L. All the common shells of the present pattern, except R.B.L. field service, have the *general service* fuze hole. They are painted black (with the exception of the studs in M.L. and the lead coating in B.L. shells), and are lacquered inside to prevent friction of the bursting charge against the sides of the shell. All field service common shells, when carried filled, have a papier-mâché wad at the bottom of the fuze hole, to prevent the powder of the bursting charge from working up into the fuze hole.

Double

Are used with the 7-pr. and 7-inch R.M.L. guns. That for the 7-pr. weighs about 12 lbs., and is used with 4-oz. charges, at high angles of elevation. That for the 7-inch weighs about 160 lbs., and is intended for use against wooden ships, &c., at short ranges.

Battering

Are approved for use with 64-pr. guns. They are similar in external form to Palliser projectiles, not having any fuze-hole in front; the head is slightly chilled, and the base is fitted with a gas-check, which is fixed by a metal plug when in store.

They are intended for use against masonry, &c., and will then be fitted with a percussion fuze in the base, instead of the plug for gas-check.

Palliser

Have the same external form as Palliser shot of the same calibre, but may be distinguished from the latter by their points, which are painted white.

NOTE.—To fill shells, vide instructions, page 57 *et seq.*

Ammunition.

Palliser shell are used for penetrating iron plates on forts or vessels. Owing to the shock on striking, the powder explodes without any fuze being required. As a rough rule it may be laid down that a shell fired with a battering charge at a distance of 200 yards from the object is capable of penetrating a depth of iron exceeding the calibre of the shell by two inches. The penetration of the 12·5-inch gun is considerably in excess of what is here laid down. Thus a 9-inch shell would penetrate about 11 inches of iron plate.

Shrapnel

Are made for all R.M.L. guns and all R.B.L. guns, except 6-pr. and 20-pr.

They are constructed on the same general principles as S.B. shrapnel, *i.e.*, to contain a bursting charge no more than sufficient to open the shell, the body of the shell itself being weakened in most calibres by internal grooves, and filled with lead or iron balls.

The bursting charge of rifled shrapnel being placed at the base of the shell, necessitates the use of a primer to carry on the flash of the fuze.

They may be distinguished from other shells by their heads, which are riveted to the bodies of the shells, and in the lighter natures are painted red.

These shells would be available against troops, and owing to the great distance to which the shell keeps up its velocity, would probably be useful up to about 3,200 yards. The shell gives a good cone of dispersion if burst within 300 yards of the object; but should the troops be in close order, it ought to be burst much nearer, and would be probably more effective if burst about 100 yards from the object.

Segment

Are made for all natures of B.L. guns, but are now to a great extent superseded by shrapnel.

Segment shells, to be effective, must be burst close up to the object fired at.

They may be distinguished from common shell by their being shorter. Their interior is also different, the bursting charge for the lighter natures being enclosed in a piece of iron gas piping.

Segment shells for field service are used with percussion fuzes only. Those for garrison service are fitted with a gun-metal bush, and can take Boxer's time fuzes for R.B.L. ordnance, Pettman's G.S. percussion fuze, or R.L. percussion fuze.

Star.

The 7-pr. star shell consists of a thin iron shell, fitted up somewhat similarly to the rifled shrapnel shell, with a wooden top

Ammunition.

covered with tin, and having a brass socket for the wood time fuze. It contains 13 magnesium stars, burning about 13 or 14 seconds; a small burster (half a dram) is placed under the diaphragm, and connected by quickmatch priming with the stars, which are thus ignited and projected out of the shell, when the burster is made to explode.

PROJECTILES FITTED FOR GAS-CHECKS BUT STORED WITHOUT THE GAS-CHECKS.

Projectiles fitted for gas-checks, and having the plug and nut, when stored without the gas-checks, should have the plug screw well home, and the nut screwed close up to the base of the projectile. Those having the plug with hexagonal head should have the plug screwed well home.

GAS-CHECKS.

Gas-checks are employed in R.M.L. ordnance, with studded projectiles, to prevent erosion* of the bore, and with unstudded projectiles (such as in the 6.3-inch howitzers) as a means of effecting rotation as well as to prevent erosion.

They will be used with all Palliser projectiles 9-inch to 12.5-inch, with 10-inch, 11-inch, 12-inch and 12.5-inch common shell, 7-inch double shell, 64-pr. battering shell, 40-pr. common and shrapnel, 7-pr. double shell, and with 8-inch and 6.3-inch howitzer shell (*vide* Changes in Material, 3374).

The gas-checks "7-inch and upwards" and "64-pr. battering," consist of a copper disc of uniform thickness with a flange at the circumference of the same diameter as the projectile, the disc at that part between the flange and the centre where it is fixed to the base, is made slightly convex to the rear.

The gas-checks for the 8-inch howitzer and for the 40-pr. are similar to those for "7-inch and upwards," except that they have projections on the rim to fit into the grooves of the rifling, they are also perforated at the flange with a few small holes with the object of ensuring the ignition of the time fuze.

The gas-checks for the 6.3-inch howitzer and the 7-pr. double shell consist of a saucer shaped piece of copper with projections to fit into the grooves, and perforated at the rim with a few holes with the object of ensuring the ignition of the time fuze. They have the concave surface to the rear.

With the 6.3-inch poly-grooved howitzers, rotation is given to the projectile by means of the gas-check having radial projections which are forced into corresponding grooves in the base of the shell.

The gas-checks for 7-inch guns and upwards are fixed to the bases by means of a screw plug and nut: the gas-checks for smaller natures of guns and for 8-inch and 6.3-inch howitzers are fixed by a screw plug with hexagonal head.

* Erosion, or scoring of the bore, is the effect produced by the rush of the powder gas over the upper surface of the projectile.

Ammunition.

Fuzes.

There are two descriptions of fuzes in the service, *Time* and *Percussion*.

FUZE-HOLE GAUGES OF SHELL, AND FUZES OF EACH GAUGE.

Gauge.	Shell.	Fuze.
Mortar ..	Mortar, 13", 10", 8" ..	Large mortar.
Common ..	S.B. common and shrapnel ..	Common, diaphragm, small mortar, time; Pettman's land service percussion.
General service	All rifled shells, except segment and common for B.L. field guns and 64-pr. M.L. Battery	5, 9, or 20-sec. B.L., time, 5, 9, 15, or 20-sec., M.L. time (<i>vide</i> foot note), Royal Laboratory percussion, Pettman's G.S. percussion and sensitive percussion.
Armstrong field service	B.L. field service, segment and common	B.L. plain percussion.
1-3" left hand..	64-pr. battering shell ..	Delay fuze.

N.B.—Time fuzes are not at present used with common shells fired from rifled guns above the 80-pr. calibre and 7-inch R.B.L.

TIME FUZES.

A time fuze is one that can be made to burst a shell at any given period of its flight, or after striking.

Time fuzes consist of a case of wood, into which is pressed *fuze composition* (except the 5-seconds, which is pressed with mealed powder, and burns at the rate of 1 inch in $2\frac{1}{4}$ seconds).

All time fuzes (with the exception of the 20-seconds and mortar fuzes) have, in addition to the composition channel, powder channels at the sides within the case, to ensure the flame passing rapidly to the charge in the shell.

The fuzes used with M.L. ordnance are ignited by the flame, on the discharge of the piece, setting light to the quick match priming round the head.

Those for B.L. ordnance have a detonating arrangement in the head, which is set in action by the shock of discharge, and ignites fuze composition.

The time of burning of fuzes given in the following pages is correct when the fuze is burned at rest, and the barometric pressure is 30 inches.

When the pressure of the air increases (as in the case of a shell moving at a high velocity), the time of burning diminishes, and *vice versa*.

The allowance to be made is $\frac{1}{8}$ of full time of burning of fuze for every difference of one inch in the height of the barometer, or for every 1,000 feet in altitude.

Ammunition.

FOR R.M.L. ORDNANCE.*5-Seconds.*

They can be used with all R.M.L. shells.

They contain two inches of mealed powder, and burn 5 seconds, when at rest.

They are marked on two sides, representing half and quarter seconds, so that they may be adapted to greater nicety of range.

They are intended for use with shrapnel shells, the accuracy of the burst of such shell in flight being of great importance, and the same accuracy or ranges not being obtainable with the 9-seconds fuzes.

They are painted red and drab colour.

9-Seconds.

They can be used with all R.M.L. shells.

They contain two inches of fuze composition, which burns 10 seconds when at rest.

They are marked on two sides, in even and odd numbers, representing half seconds.

They are painted black and drab colour.

15-Seconds.

They can be used with all R.M.L. shells, and will eventually supersede the 5 and 9-seconds. They contain 2 inches of slow burning fuze composition, which burns about 15 seconds when at rest. They are marked spirally in half and quarter seconds.

They are painted black and drab colour.

20-Seconds.

They are used for common shell.

They have four inches of fuze composition, which burns 20 seconds, when at rest.

They have no powder channels at the side, and only the last two inches of composition are marked in a spiral direction round the fuze, the numbers representing half seconds, thus, 20, 22, 24, and so on.

They are painted drab colour.

30-Seconds.

They can be used with R.M.L. common shell.

They contain about three inches of slow burning composition, which burns about 30 seconds when at rest.

They are marked specially in half and quarter seconds.

They are not prepared for less than 15 seconds.

They will eventually supersede the 20-seconds fuze.

They are painted black and drab colour.

The hook borer is not suitable for these fuzes, the gimlet borer must be used.

Ammunition.

FOR R.B.L. ORDNANCE.

The fuzes for B.L.O. are identical with those for M.L.O., except that, as there is no windage, a detonator is placed in the head, which is set in action by the discharge of the gun, and ignites the fuze composition.

The latest pattern has a safety pin to support the head of the detonator; this should not be withdrawn until just before the shell is placed in the bore.

These fuzes can be used for all shells having fuze holes of general service gauge, except that the 20-sec. cannot be used with shrapnel shell.

FOR S.B. ORDNANCE.

Diaphragm

Are used for diaphragm shrapnel shells.

The length of fuze composition is one inch; and it burns 5 seconds.

They are marked on two sides in half seconds, one side having the even, the other the odd numbers.

They are painted black and drab.

Common.

They are used with S.B. common shell, also with 12 and 24-pr. shells, fired at short ranges from the 4½ and 5½-inch mortars.

They contain two inches of fuze composition, and burn for 10 seconds.

They are marked similarly to the *diaphragm*.

They are painted black and drab.

Mortar, Large,

Are used with 8, 10, and 13-inch mortar shells.

The length of the composition is six inches, and it will burn for 30 seconds.

The fuzes are marked with five divisions to the inch in a spiral direction round the outside, the figures referring to the length of composition, but by the addition of a cipher will refer to the general half-second unit; the marking commences at two inches.

No hole is bored at the marks, they being merely indentations.

They are painted drab colour.

Mortar, Small,

Are used with the 5½ and 4½-inch mortars at long ranges.

They contain three inches of fuze composition, and burn 15 seconds.

They are marked and constructed similarly to the large mortar fuze, therefore the intervals between the holes correspond to one second of time in burning; the marking commences at one inch.

They are also painted drab.

Ammunition.

10-inch Parachute Light Fuze

Has 3 inches of fuze composition, burning 15 seconds. Its marking is different to the service fuzes, thus 6 on it means 6 seconds.

8-inch Parachute Light Fuze

Has 2 inches of slow-burning composition, and burns 13 seconds. These two fuzes on emergency might be used with S.B. common shell.

5½-inch Parachute Light Fuze

Has 1½-inch slow composition, burns 10 seconds. Too small for use with S.B. common shell.

The parachute fuzes are painted blue, and have been up to the present time issued 50 in a cylinder.

Hand Grenade.

Used with 3 or 6-pr. hand grenades; burns 7½ seconds: they are placed in the grenade, uncapped, and lighted by a portfire. 1,200 in a half metal lined case.

PERCUSSION FUZES.

A percussion fuze is one that depends upon impact or graze for its action.

There are six percussion fuzes in the service, Pettman L.S., Pettman G.S., B.L. plain, Royal Laboratory, Sensitive, and Delay Action for base of Battering 64-pr.

The two former are for garrison, the four latter for field, siege, and garrison service, as hereafter stated. R.L. Mark I. to be used up with 7 and 9-pr. guns only.

Pettman L.S.

Can be used with all S.B. common shells tapped to receive it: such shell will be known by a cross engraved on the plug. It is made of gun metal, is conical in form, and has a screw turned on its body. Above the screwed part is a plain projecting shoulder, upon which the fuze rests when screwed home.

It will not act on graze, but only on striking some resisting substance, such as the parapet of an earthwork, or the side of a ship.

Pettman G.S.

Can be used with common, double, and segment shell of garrison calibres.

Ammunition.

It is somewhat similar to the L.S. fuze in general construction, but may be distinguished from it by the absence of the projecting shoulder, and by its being screwed its whole length.

This fuze will not act on graze on water, but will do so on striking the side of a ship or equivalent resistance.

The Pettman fuzes require no preparation.

B.L. Plain

Is made of gun metal, and is cylindrical in form.

A safety pin of brass wire twisted double, with a loop of braid attached to the end, is passed through the head of the fuze.

To prepare the fuze, the safety pin is withdrawn by a smart pull on the braid, the fuze dropped into the shell, and the screw plug replaced in the fuze hole.

This fuze is only used with segment shells for field guns, and B.L. common shells fitted with a socket.

It is intended to burst the shell on graze or impact.

R.L.

This fuze is adapted for all shells with fuze holes of the general service gauge, but is not used in higher calibres than the 80-pr. and 7-inch R.B.L.

Its interior is similar to that of the last fuze, but the lower part of its body is screwed to fit the G.S. fuze hole.

Through the head of the fuze passes a safety pin, with ring attached, which should not be withdrawn until the shell is in the bore.

It is intended to burst the shell on graze or impact.

Sensitive.

For use with 7-pr. R.M.L. guns, 6.3-inch and 8-inch howitzers.

It is designed so as to be equally efficient with very low charges and with the highest charges used with the above pieces.

No preparation is required except "uncapping," which is performed in the same manner as for M.L. time fuzes.

When firing with low charges, gun-cotton priming may be used to secure ignition, as described on page 63.

Delay Action for base of Battering Shell, 64-pr.

This fuze is intended to burst the shell after the shell has buried itself in the object fired at. It is set ready for action on firing similarly to an ordinary percussion fuze, and the detonator being fired on impact, ignites a column of composition, which burns a few seconds before communicating with the burster.

Ammunition.

Means of Firing Ordnance.

COPPER FRICTION TUBES

Are now almost exclusively used for firing ordnance. There are three natures, .2 inch diameter :—

The special friction tube (about 2 inches long) for the 7-pr.

The long friction tube (about 5 inches long) for 7-inch R.M.L. guns and upwards.

The short friction tube (about 3 inches long) for all other ordnance.

PORTFIRES.

Common

Burn at the rate of about one inch in 50 seconds.

The readiest way to extinguish a portfire is by a sharp, sudden jerk. When put out in this way, the burnt end should be cut off, otherwise difficulty will be experienced in re-lighting it.

Slow

Are made by saturating paper with a solution of saltpetre.

They may be used on an emergency instead of common portfires or slow match.

MATCH.

Quick

Is made of cotton wick boiled with a solution of meal powder and gum in about the following proportions:—2 lbs. wick, 20 lbs. meal powder,* 9 oz. gum arabic, 9 pints of water.

Unenclosed it burns at the rate of about 1 yard in 13 seconds; when enclosed in a tube of any kind, it burns much more rapidly, being as instantaneous as a train of gunpowder, the pressure causing the gas to rush forward and fire the mass explosively. Quick match is made up in paper or calico tubes when this rapid action is required, and when so made up is termed a "leader."

The proportions of powder, &c., will vary with the number of threads in the wick; those given above are for six-thread wick. Quick match is demanded by weight; 1 lb. of six-thread match would be about 360 feet long. Quick match is largely used for priming fuzes, &c.

Issue. Either in long packing or in metal-lined cases, and should be demanded by weight.

* A portion of the powder is kept dry, and dusted over the quick match.

Ammunition.

Slow

Is made of pure hemp, slightly twisted and boiled in a ley of water and wood ashes in the proportion of water 50 gallons, wood ashes one bushel; this serves for 100 lbs. of yarn. It burns at the rate of one yard in eight hours; it is used for lighting portfires, &c. Slow match may be equally well made by boiling in a solution of 8 oz. saltpetre to one gallon of water.

PRIMERS FOR VENT PIECES OF R.R.L. GUNS.

Are used with the 7-inch and 40-pr. R.B.L. guns, and consist of a cylinder of leather paper, driven like a tube, with three strips of red worsted attached to the exterior.

To prime, the primer is pressed into the vent, worsted end first.

TIN CUPS.

To prevent, as far as possible, the escape of gas on discharge in R.B.L. guns, tin cups are issued as under:—

For the 7-inch	{	With service, practice, and exercise ammunition.
„ 40-pr.	{	With practice ammunition.
„ 12-pr.	{	
„ 9-pr.	{	
„ 6-pr.	{	

Each cup may be used until it loses its shape.

They are placed against the cartridge with the edge to the front. A small extractor hook is provided, by which to withdraw them after firing.

WADS.

Grummet.

Grummet wads are used with all S.B. guns when firing at angles of depression, or at angles of elevation less than 3°. They are placed over the shot, and thus prevent it from running out. The cross pieces should be towards the muzzle when rammed home.

Grummet wads are supplied on special demand for use when firing rifled projectiles at angles of depression.

Wedge.

Wedge wads. Two sizes of wedge wads are issued. They both consist of two wooden wedges connected by a piece of cane.

In the larger wad the length of cane is 7.5 inches, and length of wedge 7 inches. It is for use with 9-inch guns and upwards.

Ammunition.

In the smaller wad the length of cane is 6.5 inches, and the wedge 5.5 inches long. It is for use for 64-pr., 80-pr., and 7-inch guns.

These wads are to be rammed home separately after the projectiles. Their use is to prevent the projectile from shifting when running the gun up.

ROCKETS.

Rockets are projectiles containing their own motive power, and consist of a cylinder driven with a quick-burning composition, closed at one end. The pressure of the ignited composition on the head of the cylinder (caused by the gas being free to escape to the rear), gives it an onward motion. A cone-shaped hollow is formed in the rear of the composition with the object of exposing a large surface for ignition at once, and thus obtaining a sufficient volume and pressure of gas to start the rocket with a fair velocity.

There are two natures of rockets in the service, War and Signal.

War

Are now made of Hale's pattern. The case is of steel ("Atlas metal") and corrugated, the better to retain the composition. A spinning motion is given to the rocket by the gas on its escape from the vents, of which there are three, impinging against small iron curved shields.

The head of the rocket is hollow, plugged with wood. A carcass or shell of some kind will no doubt eventually be attached to it.

There are two natures of Hale's rockets, viz., the 24-pr. for garrison or siege service, and the 9-pr. for field service.

They are painted red.

Signal

Are made of the following sizes, viz., 1 lb. and $\frac{1}{2}$ lb.

Their cases are made of paper, and have one central vent. A stick is attached to the side of the rocket, and fits into a metal socket.

All signal rockets are painted stone colour.

Ammunition.

Regulations to be observed in Making Up Cartridges, Filling Shells, and Examining Ammunition in Laboratories in Artillery Charge.

1. In most works, Laboratories have been erected, consisting of a lobby with barrier at the entrance, and filling rooms for Shells or Cartridges with hatches or openings for the admission and delivery of Powder or Filled Cartridges and Shells. Where no Laboratory Building exists a tent will be used.

2. Laboratory operations will be carried on under the superintendence of an Officer, who must satisfy himself that the several Men, as detailed in the following paragraph, understand the duties entrusted to them. The presence of an Officer will not, however, be necessary at small detached forts or batteries in charge of Master Gunners, where Ammunition is made up for the Auxiliary Artillery.

3. The party for Laboratory operations may be detailed as follows:—

- (a) Two Men as Magazine Men, to issue the Powder in barrels from the Magazine, and receive and stow Cases or Cylinders containing made-up Cartridges.
- (b) Four men for conveying the powder barrels and cases with Cartridges or filled Shells to and from the Laboratory. Two men will be sufficient if only one barrel of Powder, or less, be required.
- (c) Eight Men for the Cartridge or Shell-filling Room, or less, if a small quantity of Ammunition is to be made up. These Men will be detailed to unhead the barrels, weigh out charges, make up cartridges or fill Shells, as may be required.
- (d) Two men will be required at the entrance or receiving hatch, to pass in empty Shells.

4. The Men engaged in the Laboratory will exchange their Clothing for Laboratory Clothing and take off their boots in the place ordered, and step into the Laboratory slippers on the inside of the barrier; they will on no account re-pass the barrier, without first taking off their slippers, and will then change their clothing as before in this lobby.

5. Previous to being told off, the men must be warned to lay aside any knives, pipes, matches, or combustibles they may have about them. Any infringement of this Rule will be dealt with as disobedience of orders.

6. The operations for filling Shells and making up Cartridges will never be carried on at the same time in the same room or tent.

7. The greatest attention will be paid to cleanliness in all parts of the Laboratory and the ways leading thereto; also in the wagons and barrows used for the conveyance of the Powder or

Ammunition.

Ammunition to or from the Laboratory. Any loose grains of powder, dust, or grit, will at once be swept up and thrown into a bucket or tub containing water, which, with a stick for the purpose of stirring, is to be kept just outside the Laboratory.

8. No barrow, tool or tackle used outside, will be admitted within the barrier at the entrance of the Laboratory.

9. Nothing will be kept inside the barrier of the Laboratory but the necessary Articles for a Laboratory, and no stores such as barrels, cases, cylinders, &c., will be admitted without being thoroughly cleaned externally.

10. The Shells to be filled will be placed outside the entrance to the Laboratory or hatch, lettered "For admission of Shell," if there be one, they will there be thoroughly cleaned and brushed externally before being passed into the Laboratory—planks being laid down when the heavier Shells are filled, in order to save the floor.

11. All Shells, previous to filling, will be carefully searched internally, and all loose filings or pieces of lacquer removed. Care must be taken not to detach the lacquer in this examination; this is often done by the careless use of the copper scraper.

12. All Shells, up to the 9-inch, inclusive, can be up-ended by hand on the blocks, for examination and filling. Heavier Shells require the tackle and strap. Care must be exercised in all cases when moving projectiles which are fitted with gas-checks, not to injure the gas-checks.

13. Made-up Cartridges or filled Shells will not be issued by the same door or hatch through which the loose powder or empty Shells are passed in.

14. Powder barrels will be conveyed to the Laboratory, and zinc cylinders containing filled Cartridges to the Magazine or Cartridge Store, in barrows, in order to keep them free from dirt or grit. Covered two-wheeled barrows are generally provided for this purpose, if hand-barrows are used, the packages must be covered over with wadmiltits.

15. The floor of the chamber in the Laboratory appropriated as a filling-room, will be covered with hides or wadmiltits when in use.

16. Empty Powder Barrels will be passed out at once, and stored in a clean place; and in the event of a barrel not being emptied, it will be re-headed and returned to the Magazine.

17. No greater quantity of Powder than is absolutely necessary to keep the work going will be in the Laboratory, or in transit between the Magazine and Laboratory at the same time. The actual quantity must depend on the nature of the Cartridges to be made up or the shells to be filled, the great object in view being of course, to minimize the damage resulting from a possible explosion. In no case should the quantity exceed two barrels.

18. The foregoing regulations are applicable as a rule to filling cartridges and shells for all natures, but cartridges over 80 lbs.

Ammunition.

and shells over 10-inch R.M.L. will generally be filled at district Laboratories under special regulations as to the amount of powder and number of shells to be under manipulation at the same time.

19. A copy of these instructions attached to a board will be hung up in the entrance to the Laboratory. Copies for this purpose, printed on foolscap, can be obtained on demand.

Instructions for the Preparation of Shells and Fuzes.

FILLING AND SECURING SHELLS.

All shells should be scraped and cleaned both internally and externally before filling.

SMOOTH BORE ORDNANCE.

Shells, Spherical, S.B., Common.—Remove the plug from the fuze-hole by means of the key; insert the funnel and pour in the bursting-charge; carefully wipe every portion of powder from the fuze-hole, and when for F.S. drive in a papier-mâché wad with the drift as far as the shoulder on the drift will allow; then screw in the fuze-hole plug, or gun fuze, as required.

Shells, Spherical, S.B. Diaphragm Shrapnel, Boxer.—Remove the plug from the loading-hole by means of a screwdriver; hold the shell in a position with the loading-hole uppermost; insert the funnel and pour in the bursting-charge; turn the shell from side to side to facilitate the filling; carefully wipe every portion of powder from the loading-hole, and drive in a papier mâché wad with the drift as far as the shoulder on the drift will allow, and screw in the plug; unscrew the fuze-hole plug, to which is attached a wood plug covered with serge (to prevent the bursting powder from passing into the socket in sufficient quantity to cause inconvenience in fixing the fuze); and in order to insure the small hole communicating with the powder-chamber being clear, shake a few grains of powder from the powder-chamber into the socket; then replace the fuze-hole plug.

Shells, Spherical, S.B., Mortar.—Mortar shells are only filled when required for firing. Remove the cork from the fuze-hole, except in the case of the 10 and 13-inch, when it may be driven in; insert the funnel and pour in the bursting-charge, and insert the fuze as described under head of "preparing fuzes."

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Ammunition.

RIFLED ORDNANCE.

Shells, Rifled, M.L., Common and Double, 64-pr. and upwards.

—Remove the plug from the fuze hole, place the filling-rod in the bag, and fold the latter round the rod, insert it through the fuze hole, taking care not to force the end of the rod through the bottom of the bag; carefully push in the bag until the neck only is in the fuze hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling: then withdraw the rod, and insert the funnel in the neck of the bag, pressing the funnel well down into the fuze hole; pass the filling-rod down through the funnel, and *gradually* pour in two or three pounds of powder; take out the funnel and rod, lift up the bag, and jerk it, so as to "set" the powder well down to the bottom and to open the bag. Then reinsert the funnel and rod as before, and continue the filling.

The filling-rod should be moved up and down to facilitate the passage of the powder through the funnel, the powder in the shell being tamped on at the same time. The use of a large mallet against the side of the shell (or any piece of wood that would answer the same purpose) will materially assist in getting as much powder as possible into the shell.

When the shell is quite full, withdraw the funnel and filling-rod, and tie the neck of the bag with two half-hitches of twine close to the top of the fuze hole. Cut off the superfluous choke, and push the neck of the bag well down, and to one side of the fuze hole; then screw in the fuze or plug as required.

When the shell is to be fuzeed with a time fuze, it must not be quite filled with powder, but sufficient space must be left for the insertion of the fuze when the choke of the bag is pushed in.

No preparation of the bag by pricking or otherwise is necessary when using either percussion or wood time fuzes, except in the case of the 20-seconds fuzes, which require that the bags should be pricked. A sharply pointed piece of wood should be used.

Shells, Rifled, M.L., Common and Double, under 64-pr.—

Remove the plug from the fuze hole, insert the leather funnel, and pour in the bursting-charge; the shell should be tapped with a mallet or a piece of wood, to ensure its being completely filled, just leaving room for the fuze, if it is to be fuzeed with a time fuze. This can be ascertained by inserting a piece of wood the same size as the fuze. After filling the shell carefully, wipe every portion of powder from the fuze hole, then fix the fuze or plug as may be required.

In shells that are liable to be travelled, or that are not required for immediate use, insert the wad, papier-mâché, G.S., with the side on which the shalloon is cemented downwards, i.e., next the powder; drive it in with the "Drift, wood, G.S.," as far as the shoulder on the drift will allow, and then screw in the fuze or plug as may be required.

Ammunition.

Shells, Rifled, M.L., Battering, 64-pr.—The shell is to be placed upon its point in any convenient place to steady it.

Remove the gas-check plug with the "spanner gas-check plug for 64-pr., &c.;" take off the gas-check, and fill the shell as directed for the smaller natures of common shell, then carefully wipe every portion of powder from the fuze hole, replace the gas-check, and insert the fuze or plug as may be required, and screw it well home with the "spanner," until it binds against the gas-check.

Shells, Rifled, M.L., Palliser.—The shell is to be placed upon its point, which may be inserted in a block of wood hollowed for the purpose, or in any convenient place to steady it. No special pattern of block is necessary: it can be provided on the spot, and the recess cut by any carpenter.

Pass the "Holder, shell, Palliser" over the base until it rests on the rear studs, then, whilst it is held firmly by another man, unscrew the nut with the "Spanner, gas-check, plug," remove the gas-check, if it has already been fixed, and then unscrew the gas-check plug with the "Wrench removing base plugs of Palliser shells."

N.B.—The 7-inch and 8-inch Palliser projectiles are not fitted for gas-checks, they, therefore, only require the base plug to be removed.

Thoroughly clean the screw-thread of the plug-hole with a piece of cotton waste or rag.

Insert the bag for bursting charge, and fill the shell as directed for the larger natures of common shell.

Before replacing the plug, any grains of powder or grit adhering to either screw must be thoroughly removed, and the screw threads lubricated.

Insert the gas-check plug and screw it well home with the "Wrench removing base plug of Palliser shells;" in the 7-inch and 8-inch the base plug only requires replacing.

Place the gas-check on the base of the shell with the concave or unpainted side next the base, then screw the nut on to the end of the plug with the "Spanner" till the nut binds against the gas-check.

Shells, Rifled, M.L., Shrapnel, Boxer.

Remove the plug from the fuze hole, and after seeing that the fuze hole is clear of any dirt, &c., insert the leather funnel and pour in the bursting-charge. This must be done gradually, for if the whole of the powder is put in at once the tube will probably become choked. Shake the shell from side to side on its base, until the whole of the bursting-charge has passed down the tube, taking care that none of the powder is left at the bottom of the socket. Drop in the metal primer, and, by means of the large diaphragm Shrapnel screwdriver, screw it tightly into the tube, and then screw in the fuze or plug as may be required.

(A. M.)

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Ammunition.

Shells, Rifled, B.L., Common and Segment.

The common and segment shells, 40-pr. and upwards, and the 20-pr. sea service common shell, are to be filled as directed for the smaller natures of R.M.L. common shell. In the common shell, 20-pr. land service, 12-pr. and 9-pr., which are fitted with a metal socket to carry the B.L. percussion fuze, insert the leather funnel, and carefully pour in the bursting-charge through the small hole at the bottom of the socket, until the shell is thoroughly filled; then (care being taken that no powder remains in the socket) place the papier-mâché wad, recessed part uppermost, in the hole at the bottom of the socket, and drive it in flush; any flat-ended piece of wood or stick larger in diameter than the wad can be used for this purpose; then fix the fuze or screw in the fuze hole plug, as may be required.

The object of this wad being used is to prevent the powder from working up into the socket after the shell has been fuzeed.

It is not necessary to remove the wad when the shell is to be fired, as the explosion of the fuze is sufficient to force it into the shell.

The 20-pr., 12-pr., 9-pr. and 6-pr. segment shells have iron bursters, a wood plug covered with serge being placed on top to secure them whilst travelling: this plug is to be removed when the percussion fuze is inserted.

Shells, R.B.L., Shrapnel, Boxer, Land Service.

Filled as directed for R.M.L., Shrapnel, page 59.

FIXING GAS CHECKS.*Projectiles fitted with plug and nut.*

Unscrew the nut and remove it, then apply the "Wrench removing plug" to the gas-check plug, and screw it well up in the direction of the arrow,* to ensure its being well home.

N.B. When unscrewing the nut, if there is any tendency for the plug to unscrew also, the "Wrench, removing, plug," should be at once applied to the head of the plug and turned in the direction of the arrow, at the same time as the nut is being turned in the opposite direction.

Place the gas-check on the base of the projectile, with the concave or unpainted side next the base, then screw the nut on to the end of the plug with the "Spanner, gas-check, plug," until the nut binds against the gas-check.

Projectiles fitted with plug with hexagonal head.

Unscrew the plug and remove it. Place the gas-check on the

* The heads of the gas-check plugs, and the wrought-iron nuts, are stamped with an arrow to show the direction in which to turn, either when screwing in the gas-check plug, or when screwing on the wrought-iron nut.

Ammunition.

base of the projectile with the concave or unpainted side next the base (the saucer shaped gas-checks for 6.3-inch howitzer and 7-pr. double, with the concave surface to the rear), insert the plug and screw it well home with the spanner until it binds against the gas-check.

N.B. With gas-checks having projections for studded projectiles, see that the projections are in the line of the studs before screwing the plug home: with the 6.3-inch howitzer shells see that the radial projections on the gas-check fit into the corresponding grooves in the base before screwing the plug home.

FIXING PLUGS AND FUZES.

When plugs, primers, or metal fuzes are screwed into shells they should be lubricated with a mixture of equal parts of coconut oil and finely powdered chalk. If this is not available, with beeswax and Rangoon oil, or with white lead and tallow.

Palliser and other projectiles fitted with plugs, and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water, or otherwise, should have their plugs unscrewed once at least every six months, and the screws cleaned and re-lubricated as above.

Instances have occurred in which fuze hole plugs of common shell have been so jammed in as to be immovable in consequence of using the "wrench, removing, plug," intended for Palliser base plugs. The "key iron, fuze and plug, G.S.," and the "key iron, plug, G.S.," are the only implements which should be used for screwing in the G.S. plug.

DISTINGUISHING MARKS.

All filled shells must be marked in red paint with the word "Filled," and date, and also "bag," if a bag is used.

REGULATIONS FOR STORAGE OF FILLED PROJECTILES FITTED FOR GAS-CHECKS IN CHARGE OF THE ROYAL ARTILLERY.

Projectiles in charge of the Royal Artillery are to be filled and the gas-checks fitted before being placed in the shell store.

In storing the shell, they are to be placed resting on their gas-checks, the stability being ensured by two pieces of wood 9" x 1" square placed each side of the nut.

Ammunition.

PREPARING FUZES.*Fuzes, Time, Wood, Boxer.*

The Boxer wood time fuzes are prepared for any desired time of flight by boring through the side hole corresponding to the required time into the composition.

When using the hook-borer, place the fuze in the hook of the hook-borer in the proper position for boring the required hole; enter the bit into the side hole, screwing up until the bit has entered as far as the borer will allow, taking care not to press upon the fuze so as to prevent its bedding fairly in the hook.

Unscrew, and when the bit is quite clear, remove the fuze from the hook. The length of the bit is so regulated that, when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder. If the bit should become unserviceable, the handle must be detached from the shank and the tightening-screw unscrewed, the square hole in the hook being made for that purpose. Care must be taken, when substituting another bit, that it is properly placed in the handle, and that the tightening-screw firmly presses upon it, for if any space be left between the handle and the head of the bit, the end will not enter a sufficient depth into the composition. The borer should be occasionally examined and cleaned. The operation of preparing the fuze and fixing it in the shell takes, on an average, about 15 seconds; with a little practice these operations may be performed in a shorter time.

When using the gimlet borer, hold the fuze in the hollow of the hand, enter the borer into the side hole, pressing it in perpendicular to the axis of the fuze; when it has reached the bottom of the hole, use it as a gimlet to complete the communication with the composition, boring up to the handle; then pull the borer straight out.

FIXING FUZES.*Fuzes, Percussion, B.L. Plain.*

These fuzes are used in the B.L. 20-pr., 12-pr., 9-pr., and 6-pr. segment shells, and in the 20-pr. land service, 12-pr. and 9-pr. B.L. common shells; they require no preparation except the removal of the safety pin, which is to be taken out just before dropping the fuze into the shell. Care must be taken to insert it properly; the part with the rim round it is the top of the fuze; it should be firmly held in its place by the fuze-hole plug being screwed tightly down on to it.

Fuzes, Percussion, Pettman, G.S.

These fuzes require no preparation; they are simply screwed firmly into the fuze-hole by means of the key, iron fuze and plug G.S.

Ammunition.

Fuzes, Percussion, R.L.

These fuzes require no preparation except the removal of the safety pin. They are screwed firmly into the fuze hole by means of the "Key, iron, plug, G.S."

The safety pin is *not to be* removed until the shell is placed in the muzzle of the gun.

Fuzes, Percussion, Sensitive.

The fuze is "uncapped" by removing the tape and copper band; this is not to be done till the shell has been placed in the bore; after uncapping the fuze fray out the two loose ends of the quickmatch, then take a piece of guncotton yarn about 10 inches in length, place the centre of it alongside the quickmatch where it is tied to the fuze and twist the two ends (quickmatch and guncotton) on either side together and wrap them round the head of the fuze, tying the guncotton yarn in a knot at the ends.

N.B. No thread or twine must be used.

Fuzes, Percussion, Delay Action, for base of Battering Shell, 64-pr.

These fuzes require no preparation: they are to be screwed firmly into the base of the shell, as directed under instructions for filling battering shell, 64-pr.

Fuzes, Time, Wood, Boxer, Breech-Loading.

The fuzes for B.L. shells should be screwed into the fuze hole by hand; when they cannot be screwed any further, they are properly secured. *In fixing the B.L. Boxer time fuzes, neither a mallet nor any other instrument is to be used.* The safety pin is not to be withdrawn until just before entering the shell into the breech.

Fuzes, Time, Wood, Boxer, Muzzle-Loading.

The fuzes for muzzle-loading shells are fixed in the fuze hole by giving the head of the fuze two or three smart taps with a mallet, or suitable piece of wood, or by striking them against the gun carriage if more convenient; this operation should be performed fairly, and not so as to split or injure the top of the fuze; the fuze must not be uncapped until the shell is placed in the muzzle of the gun. The fuzes for rifled M.L. guns are "uncapped" by taking hold of the small end of the copper band, which is left exposed, and unwinding from left to right smartly, so as to thoroughly detach the band from the head of the fuze, and to leave the priming fully exposed.

Fuzes, Time, Wood, Boxer, Common and Diaphragm.

Remove the fuze-hole plug and place the fuze in the fuze-hole of the shell, and give the head of the fuze two or three smart taps

Ammunition.

with the mallet, or against the gun carriage if more convenient. Before the fuze is placed in the socket of the diaphragm shell, care must be taken to remove any superfluous quantity of powder which may have passed into the socket through the communication hole. This is important, because the shell will burst prematurely if the powder in the socket prevent the fuze being securely fixed.

The fuze should not be uncapped until the shell is placed in the muzzle of the gun: this much reduces the chance of an accident and secures the priming from injury.

Gun Cotton Priming.

Gun cotton priming has been introduced for use when firing at high angles with small charges, as the quick-match failed to ignite.

The gun cotton is issued in tin cylinders containing 20 feet of loosely twisted gun cotton and strands of silk for attaching it to the fuze, the cylinder holds enough for about 20 fuzes, it is closed by a band of tape.

The directions for use are enclosed in each cylinder and are stated under head, fuzes, sensitive, page 63.

It is well to remember that when the gun cotton is attached, the fuze is liable to be ignited by the least spark, therefore the shell should be placed in the gun as soon as possible after the gun cotton is attached.

Wad, Papier-mâché, in Fuze Hole.

When fixing fuzes in shells having a wad in the fuze hole, or in the bottom of the socket of 20-pr. land service, 12-pr. and 9-pr. B.L. common shells, it is not necessary to remove the wad, as the explosion of the fuze is sufficient to force it into the shell, if using percussion fuzes; and if using wood time fuzes the wad should be driven into the shell in the operation of fixing the fuze.

EXTRACTING WOOD FUZES.

Fuzes for Rifled Ordnance.—Apply the fuze-extractor to the head of the fuze and unscrew; if the adapter which is in the fuze-hole of some B.L. shells should also be unscrewed, do not remove the fuze from it by striking it on the end, as a blow in that direction may weaken or break the wire that suspends the hammer in the breech-loading fuze.

Fuze for Common and Diaphragm Shrapnel.—Clear out the cup of the fuze with the projecting piece of metal on the handle of the fuze-extractor; take a firm hold of the head of the fuze between the jaws of the fuze-extractor and turn from left to right. The small knob between the jaws fits into the cup of the fuze and prevents the top from collapsing or giving way.

An "Extractor, fuze, large," is supplied for use with 13, 10, and 8-inch mortar shells on demand.

Ammunition.

TABLE OF FILLED CANNON CARTRIDGES.—RIFLED ORDNANCE.

Nature.	Description.	Charge.	Length.		Diameter.		Number and Description of Hoops.	Number Packed, and Weight of Package in Pounds, Cases, Powder, Metal Lined.					
			From	To	Body.	Bottom.		Whole.		Half.		Quarter.	
			Ins.	Ins.	Ins.	Ins.		No.	Wgt.	No.	Wgt.	No.	Wgt.
Rifled Muzzle-Loading.	12.5-in. 38 tons	Service ... 160 lb. P. ^a α ...	19.75	...	12.0	10.4	11 Broad	...	...	...	...	...	...
	12-inch 35 tons	Battering ... 110 lb. P. ...	27.5	28.5	11.5	9.9	16 "	...	...	...	...	...	...
		Full ... 85 lb. P. ...	21.5	22.5	11.5	9.9	12 "	...	...	...	...	...	...
		Full ... 67 lb. R.L.G. ...	18.4	19.4	11.0	9.9	12 "	...	...	...	...	...	...
	12-inch 25 tons	Battering ... 85 lb. P. ...	21.5	22.5	11.5	9.9	12 "	...	...	...	...	...	...
		Battering ... 67 lb. R.L.G. ...	18.4	19.4	11.0	9.9	12 "	...	...	...	...	...	...
		Full ... 55 lb. P. ...	14.25	15.25	11.5	9.9	7 "	...	...	...	...	...	...
	11-inch ...	Full ... 50 lb. R.L.G. ...	14.5	15.5	11.0	9.9	7 "	...	...	...	...	...	...
		Battering ... 85 lb. P. ...	25.0	26.0	10.5	9.3	14 "	...	...	...	...	...	...
		Battering ... 70 lb. R.L.G. ...	24.0	25.0	10.0	9.3	14 "	...	...	...	...	...	...
	10-inch ...	Full ... 60 lb. P. ...	18.0	19.0	10.5	9.3	10 "	...	...	...	...	...	...
		Full ... 50 lb. R.L.G. ...	18.0	19.0	10.0	9.3	10 "	...	...	...	...	...	...
		Battering ... 70 lb. P. ...	25.0	26.0	9.5	8.25	13 "	...	...	...	...	...	...
	9-inch ...	Battering ... 60 lb. R.L.G. ...	25.0	26.0	9.0	8.25	13 "	...	...	...	...	...	...
		Full ... 44 lb. P. ...	16.3	17.3	9.5	8.25	8 "	...	...	...	...	...	...
		Full ... 40 lb. R.L.G. ...	17.5	18.5	9.0	8.25	8 "	...	...	...	...	...	...
	8-inch ...	Battering ... 50 lb. P. ...	22.5	23.5	8.5	7.3	11 "	...	...	...	...	...	...
		Battering ... 43 lb. R.L.G. ...	22.0	23.0	8.2	7.3	11 "	...	...	...	...	...	...
		Full ... 30 lb. R.L.G. ...	16.0	17.0	8.2	...	7 Narrow	3	140	...	...	...	...
	7-inch ...	Reduced, S.S. ... 15 lb. c. ...	11.0	12.0	6.8	...	4 "	...	...	...	...	...	...
		Battering ... 35 lb. P. ...	21.0	22.0	7.5	6.43	11 "	...	...	...	...	...	...
		Battering ... 30 lb. R.L.G. ...	20.0	21.0	7.3	6.43	11 "	...	...	...	...	...	...
	6-inch ...	Full ... 20 lb. R.L.G. ...	15.2	15.7	7.3	...	6 "	...	...	...	...	...	...
		Reduced, S.S. ... 12 lb. c. ...	11.5	12.0	6.26	...	4 "	...	...	...	...	...	...
		Battering ... 30 lb. P. ...	22.5	23.5	6.5	5.57	12 "	...	...	...	...	...	...
	5-inch ...	Battering ... 22 lb. R.L.G. ...	18.3	19.3	6.4	5.57	12 "	...	...	...	...	...	...
		Full ... 14 lb. R.L.G. ...	13.5	14.3	6.4	...	5 "	...	...	...	...	...	...
		Reduced, S.S. ... 10 lb. c. ...	9.25	9.75	6.4	...	3 "	...	...	...	...	...	...
	4-inch ...	10 lb. R.L.G. ...	8.75	9.25	6.8	...	3 "	...	...	...	...	...	...
		5 lb. R.L.G. ...	5.75	6.25	6.3	...	1 "	...	...	...	...	...	...
		2½ lb. R.L.G. ...	4.0	...	6.0	...	...	...	...	...	...	...	...
	3-inch ...	10 lb. L.G. ...	8.75	9.25	6.8	...	3 "	...	...	...	...	...	...
		5 lb. L.G. ...	5.75	6.25	6.3	...	1 "	...	...	...	...	...	...
		2½ lb. L.G. ...	4.0	...	6.0	...	...	...	...	...	...	...	...
	2-inch ...	4 lb. R.L.G. ...	6.0	...	5.6	...	1 "	...	...	...	...	...	...
		3 lb. R.L.G. ...	5.2	...	5.2	...	1 "	...	...	...	...	...	...
		2 lb. R.L.G. ...	4.5	...	4.6	...	1 "	...	...	...	...	...	...
	1.5-inch ...	1 lb. R.L.G. ...	3.0	...	3.5	...	1 "	...	...	...	...	...	...
		106 162 49 83	...	...	...	...	...	...	...	...	...	...	...
		110 162 50 82	...	...	...	...	...	...	...	...	...	...	...
	1.25-inch ...	4 lb. L.G. ...	6.0	...	5.6	...	1 "	...	...	...	...	...	...
		3 lb. L.G. ...	5.2	...	5.2	...	1 "	...	...	...	...	...	...
		2 lb. L.G. ...	4.5	...	4.6	...	1 "	...	...	...	...	...	...
	1.125-inch ...	1 lb. L.G. ...	3.0	...	3.5	...	1 "	...	...	...	...	...	...
		106 162 49 83	...	...	...	...	...	...	...	...	...	...	...
		110 162 50 82	...	...	...	...	...	...	...	...	...	...	...
	80-pr. ...	Service ... 10 lb. R.L.G. or L.G. ...	11.0	12.0	6.0	...	4 "	...	...	...	...	...	...
		Blank ... 5 lb. c. ...	6.5	...	6.0	...	2 "	...	...	...	...	...	...
		12 lb. R.L.G. or L.G. ...	13.0	14.0	6.0	...	5 "	...	...	...	...	...	...
	64-pr. ...	Service ... 10 lb. R.L.G. or L.G. ...	11.0	12.0	6.0	...	4 "	...	...	...	...	...	...
		8 lb. R.L.G. or L.G. ...	9.2	9.7	6.0	...	3 "	...	...	...	...	...	...
		14 162 6 79	...	...	...	...	...	...	...	...	...	...	...

α. Two 80-lb. cartridges are used for one charge of 160 lb. These cartridges are made up with a stick in the centre to an uniform length. The dimensions given are those of the 80-lb. cartridge. c. Blank or Exercise, R.L.G. or L.G.

d, e, f, see notes next page.

N.B. - The larger figures refer to cartridges packed in paper covers.

Cartridges for 7-inch R.M.L. guns and upwards, for L.S., are packed in zinc cylinders, each cylinder containing 1 cartridge, with the sole exception of the Mark II. cylinder for the 7-inch gun, which will contain 1 Battering or 2 Full charges.

Ammunition.

TABLE OF FILLED CANNON CARTRIDGES.—RIFLED ORDNANCE—*contd.*

Nature.	Description.	Charge.	Length.		Diameter.		Number and Description of Hoops.	Number Packed, and Weight of Package in Pounds, Cases, Powder, Metal Lined.						
			From	To	Body.	Bottom.		Whole.		Half.		Quarter.		
			Ins.	Ins.	Ins.	Ins.		No.	Wgt.	No.	Wgt.	No.	Wgt.	
Rifled Muzzle-Loading.	64-pr. ...	Reduced or Saluting, S.S.	6 lb. R.L.G. } or L.G.	7.5	8.5	6.0	...	2 Nr.w. {	18	160	7	73	...	...
		Blank ...	5 lb. c ...	6.5	...	6.0	...	2 " {	19	164	8	79	...	...
									22	162	10	82	...	...
	40-pr. ...	Service ...	7 lb. R.L.G. } or L.G.	13.75	14.25	4.3	...	7 " {	15	156	6	73	...	...
		Blank ...							16	162	7	80	...	...
	25-pr. ...	Service ...	4 lb. R.L.G. } or L.G.	10.75	11.25	3.6	...	6 " {	26	156	12	80	5	39
		Blank ...							27	158	12	79	5	38
	16-pr. ...	Service ...	3 lb. R.L.G. } or L.G.	9.5	10.0	3.3	...	6 " {	33	152	15	77	6	37
		Blank ...	1½ lb. c ...	5.5	6.0	3.3	...	3 " {	33	149	15	76	6	36
									74	166	33	83	13	39
	9-pr. ...	Service ...	1½ lb. R.L.G. } or L.G.	9.0	9.5	2.6	...	5 " {	60	160	27	80	10	37
			1½ lb. g R.L.G. } or L.G.	8.25	8.75	2.6	...	5 " {	65	165	30	84	11	38
			1 lb. c ...	5.75	6.25	2.6	...	3 " {	67	154	33	83	13	39
	7-pr. ...	Service ...	12 oz. F.G. or R.F.G. }	5.75	6.25	2.5	...	3 " {	68	152	33	81	13	38
			8 oz. F.G. or R.F.G. }	3.5	3.75	2.5	...	1 " {	101	155	44	77	20	39
			6 oz. F.G. or R.F.G. }	3.5	...	2.5	...	1 " {	120	172	54	86	21	40
4 oz. F.G. or R.F.G. }			2.7	...	2.2	...	1 " {	135	157	65	83	27	40	
								142	159	70	84	28	40	
								198	156	90	79	40	40	
								214	162	102	84	42	40	
Rifled Breech-Loading.	7-inch ...	Service ...	11 lb. R.L.G. } or L.G.	10.0	11.0	7.03	...	5 " {	260	154	116	78	46	37
		Blank ...	7 lb. c ...	6.0	6.5	7.03	...	2 " {	290	162	133	82	56	40
		S.S. 5 lb. R.L.G. } or L.G.	10.0	10.75	4.77	...	5 " {	380	153	170	78	72	38	
	40-pr. ...	Service ...	L.S. 5 lb. R.L.G. } or L.G.	12.25	12.75	4.77	...	6 " {	425	159	200	82	82	40
		Blank ...	3 lb. c ...	5.75	6.25	4.77	...	2 " {	8	141	3	65	...	...
		Blank ...	2½ lb. R.L.G. } or L.G.	10.0	10.75	3.77	...	5 " {	8	133	3	62	...	...
	20-pr. ...	Service ...	1½ lb. c ...	4.75	5.25	3.77	...	2 " {	15	131	5	57	2	29
		Blank ...	1½ lb. R.L.G. } or L.G.	8.0	8.5	3.02	...	4 " {	12	123	5	61	...	...
		Blank ...	1½ lb. c ...	5.75	6.25	4.77	...	2 " {	26	134	12	69	4	31
	12-pr. ...	Service ...	1½ lb. R.L.G. } or L.G.	8.0	8.5	3.02	...	4 " {	...	...	...	...	...	...
		Service ...	1½ lb. R.L.G. } or L.G.	6.0	6.5	3.07	...	3 " {	50	142	25	77	9	35
		Blank ...	1 lb. c ...	8.25	...	3.125	...	6 " {	70	154	32	78	12	36
	6-pr. ...	Service ...	12 oz. R.L.G. } or L.G.	6.25	6.5	2.53	...	3 " {	...	...	...	...	...	...
		Blank ...	10 oz. c ...	6.25	6.5	2.53	...	3 " {	100	150	48	79	18	36
								
	Bags, spare Powder	15 lb. P ³	10	201	4	91	...
15 lb. P. ...		...	...	...	...	...	...	...	10	201	4	91	...	...
10 lb. P. ...		...	...	...	...	...	...	...	15	201	...	...	...	...
15 lb. R.L.G. ...		...	...	...	...	...	...	...	8	170	4	91	...	...
10 lb. R.L.G. ...		...	...	...	...	...	...	...	12	170	...	...	...	...
15 lb. L.G. ...		...	...	...	...	...	...	...	8	170	4	91	...	...
10 lb. L.G. ...		...	...	...	...	...	...	...	12	170	...	...	...	...
Weight of Packages Empty			...	...	...	...	...	...	48	...	30	...	18	...

c. Blank or Exercise, R.L.G. or L.G.

d. For exceptional use, under certain circumstances, with 64-pr. 64-cwt. siege guns (Mark III., with steel tubes).

e. Service charge for 64-pr. 64-cwt. (Mark III. only).

f. Also reduced charge, Naval Service, for 64-pr. 64-cwt. (Mark III. only).

g. For 6-cwt. gun, S.S.

N.B.—The larger figures refer to cartridges packed in paper covers.

Cartridges for 7-inch R.M.L. guns and upwards, for L.S., are packed in zinc cylinders, each cylinder containing 1 cartridge, with the sole exception of the Mark II. cylinder for the 7-inch gun, which will contain 1 Battering or 2 Full charges.

PART III.—SIEGE ARTILLERY.

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Section I.—General Directions.

THE regular attack of a fortified place entails the employment of several kinds of ordnance. Siege artillery is organized in units which may be heavy or light, for details* *vide* page 149. Each unit is composed of 30 pieces of ordnance, and is supplemented by six 7-pr. guns of 200 lbs. each, mounted on beds for the advanced trenches, and 300 24-pr. rockets. Gatling guns, for the defence of the trenches against sorties, will probably be associated with the above.

* *Vide* also Handbook for Siege Artillery, 1879.

Section I.

General Directions.

The number and nature of units to be employed in any siege operations depend on the importance and strength of the position to be attacked. The place of disembarkation having been determined on, the transports will be unladen, by being brought alongside piers or landing places, or should the depth of water not admit of this, the stores will be transferred to flat bottomed boats or launches, and landed by such means as may be available. Should it be necessary to erect sheers and derricks on the beach or waterside, the detail of stores stated at page 151, will be found sufficient for all weights up to 90 cwt.

It will be necessary for the Officer superintending the disembarkation, to establish a system for the immediate removal of all stores from the neighbourhood of the landing places, in order that the work may proceed without hindrance, and the jetties or wharves not become blocked up by an unnecessary accumulation of material.

The Siege Train Parks will be established at such positions as to facilitate a ready supply to the trenches. These parks would be from 3 to 4 miles from the besieged fortress, and in the choice of such sites, attention must be paid to the contingency of the serious consequences of a successful sortie reaching them and destroying the contents. They should be out of sight of the enemy, and beyond the reach of their fire.

The extent, position, and number of the parks will depend on the nature of the front to be attacked. They must be such as to ensure a sufficient supply of material of all kinds.

In future sieges tramways will probably be employed to facilitate the transport of material to the batteries.

The arrangement of stores in field arsenals and parks requires a most systematic plan. Each nature of projectile should be stored separately and each pile duly marked; the metal lined cases with filled cartridges, stacked according to the nature of ordnance for which intended. Magazines and laboratory tents placed with due regard to safety; fuzes and rockets under such protection from accident and weather as the means available will permit; the artificers' shops, wheelers' or smiths', with regard to the safety of the material in the park. The men in the parks, employed in duties which require experience, should be permanent.

The general directions for the armament of the batteries are given at page 84.

When the trenches have been reported as complete to receive the guns, &c., the removal of all necessary stores will be proceeded with by the Royal Artillery.

The force composing the siege train, or parts of a siege train, should be divided into reliefs, each relief being on duty for 12 hours. This time will be found easier work for the detachments, which, as a rule will have to march probably 3 or 4 miles from their encampments to the batteries, than shorter periods.

The reliefs will be carried on generally at 6 A.M. and 6 P.M.;

General Directions.

Section I.

but no man should go on morning duty to the trenches without his breakfast. Cooked provisions should be taken down. Attention to the comforts of the men will not only add to their general health, but also enable them to maintain their efficiency under the severe work inseparable from duty in trenches.

Officers in command of detachments cannot pay too much attention to the most careful supervision of the material in the batteries: that the supply of cartridges, projectiles, fuzes, &c., is sufficient for the probable requirements: that the platforms are in good working order, and the drainage as complete as possible: that the elevating gear works well, and is clear of too much grease and free from dirt: that the distances of all important points be accurately ascertained, in order that an effective fire may at once be directed on any spot without loss of time.

The amount of ammunition required for daily consumption cannot be fixed. It depends on what the several batteries are intended for.

Officers in command of batteries cannot be too careful in limiting the expenditure to the urgent necessities of the work they are engaged on.

Section II.—Jetties.

In suitable localities, with sufficient time, material, and appliances, and the requisite command of manual labour, wooden piers or jetties may be constructed of strength sufficient for the disembarkation of siege or even heavier guns; but it would rarely, if ever, fall to the lot of the artilleryman to be called upon to execute engineering works of such magnitude; still it is not improbable that a knowledge of the mode of constructing jetties, such as would be suitable for the disembarkation of weights up to one ton might prove of use; and although exact rules cannot be laid down as to the proper mode of proceeding in every case, the following hints might prove useful.

CONSTRUCTION OF WOODEN JETTY OF PILES OR TRESTLES.

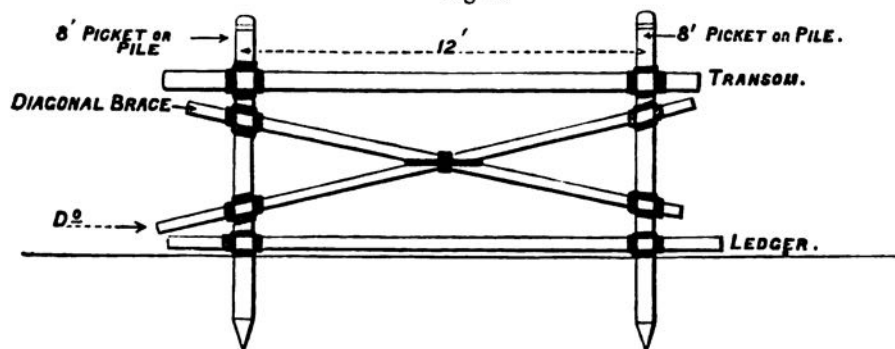
The spot selected should be free from exposure to a heavy sea.

The more gradual the slope of the beach the longer must be the jetty, to secure a given depth of water at the head: this may be of importance in selecting a locality if stores are limited.

Good holding ground, in which piles can be driven, should if possible be fixed on.

The jetty may be described as consisting of a number of upright frames, Fig. 1, which carry the road bearers and deck.

Fig. 1.



The width of the frames would, to a certain extent, be regulated by the length of the planks intended to be made use of for the deck, but it should be broad enough to ensure stability—about 10 or 12 feet, generally speaking.

Spars of about 6 inches diameter would be suitable for the transoms, and somewhat lighter scantling for the diagonal braces and ledgers.

For the piles, 8-ft. pickets for shallow water; iron-shod piles or trestles would be used as the water deepened.

Jetties.

Section II.

Swiss pile drivers, or monkeys for pile driving. Lashings, $2\frac{1}{2}$ -inch tarred rope for the transoms, and $1\frac{1}{2}$ -inch tarred for the diagonals and ledgers.

The intervals between the frames would depend on the strength of scantling employed for the road bearers, and the number of road bearers laid down in each bay.

Using five 5-inch baulks as road bearers in each bay, about 10 feet interval between the frames would be suitable for field guns or like loads.

Planks laid down in the wheel track on top of the deck serve to distribute the weight.

By lashing the road bearers to the transoms great increase of stability is obtained.

Baulks or ribands may be lashed down along the sides of the deck to keep the planks from moving.

Collars of light lashing applied under each transom lashing on the upright piles, keep the transoms from slipping down when the weight comes on them.

Fig. 2.

SIDE ELEVATION OF LIGHT JETTY.

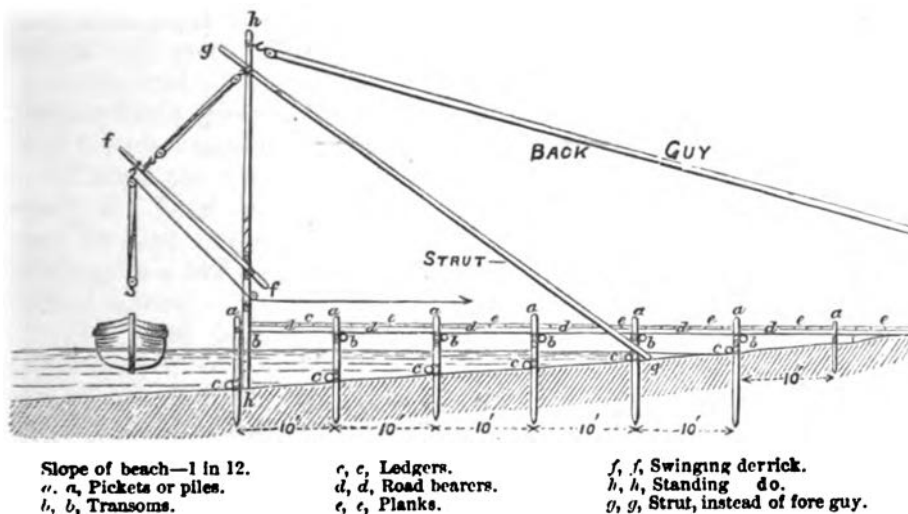


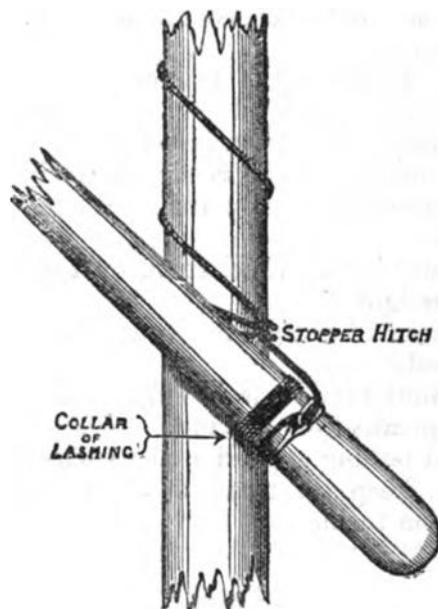
Fig. 2 gives a side elevation of a light jetty run out on a beach having a slope of 1 in 12.

The swinging derrick, *f, f*, rigged at the end of the jetty, from the standing spar, *h, h* (which has the strut *g, g* instead of a fore guy), would be for the disembarkation of light guns or stores.

The diagonal braces of the frames, and the side guys of the derricks, are not shown, to avoid confusion.

The butt of the swinging derrick is made fast to the upright spar, with a 6" gasket secured to the former, as shown in Fig. 3, and to the latter with a stopper hitch.

Fig. 3.



MODE OF SECURING SWINGING DERRICK TO UPRIGHT SPAR.

Sheers.

Section III.

Section III.—Sheers.

RIGGING, RAISING, AND WORKING LIGHT SHEERS FOR THE
DISEMBARKATION OF GUNS, &c., NOT EXCEEDING 90 CWT.

As a rule the sheers would be erected on the edge of a quay or pier where large boats or barges could lie alongside, and as in such cases an anchor holdfast would probably have to be made use of for the fore guy, in the following description this has been assumed to be the case. In any instance where the fore guy holdfast could be established on solid ground, it might be constructed in the manner prescribed for the back guy.

ERECTING LIGHT SHEERS, 40-FOOT SPARS, ON THE EDGE OF A
QUAY, END OF A PIER, OR ON AN OPEN BEACH.

The stores required* for the work (as detailed at page 151) having been landed and placed in a convenient position, the spars would be carried to the spot where it was intended to erect the sheers. A convenient way of carrying the spars when wheel transport is not available, is to lash handspikes across them with light lashing at close intervals, man the handspikes on both sides, and walk away with the spars, one at a time. Each spar weighs about $13\frac{1}{2}$ cwt. The spars should be skidded with their heads near the end of the pier at a convenient height for rigging, their feet or butts lying inboard and opened out to an interval of 13 feet 4 inches measured from centre to centre.

Unless the "splay" is thus made one-third of the length of the spar, the head bolt cannot be inserted. The feet of the spars may be kept at the proper distance apart, and from opening out in raising, by a luff tackle made fast between their butts, or by a spar lashed across.

The head bolt is inserted and keyed up; the main tackle, consisting of two treble 12-inch Bothway blocks (so rove with a coil of 4-inch white rope, that the running end comes off from the *centre* sheave of the upper block to guard against twist) is hooked into the large shackle at the head of the sheers, and the tackle overhauled until the lower or moveable block comes close down to the feet of the sheers. The lower block is then secured to the butt of one of the spars.

The back guy, that is the one on the land side, will consist of three lengths of wire rope, each 22 feet long, shackled together; the upper end is shackled to the head bolt of the sheers, and into the eye at the lower end is hooked the moveable block of the guy tackle.

The back guy tackle will consist of one treble 12-inch Bothway

* Special stores for holdfasts, such as anchors, chains, &c., are not provided for in the detail quoted.

(A. M.)

Section III.

Sheers.

block and one double ditto. The double block is moveable and hooked into the lower end of the wire guy, the treble block is made fast at the holdfast. The guy tackle is rove with a half coil (56 fathoms) of 4-inch white rope.

The crab capstan may be established in any convenient position.

When using an anchor holdfast laid down under water for a fore guy, the following is a most convenient method of rigging and working the guy.

Assuming that the sheers will be raised by the back guy and will not be heeled inwards, the following arrangement would give ample power for the fore guy, be very convenient for working, and keep the guy tackle out of the water.

The fore guy consists of 60 feet of chain, three lengths of wire rope shackled together, giving a total length of wire rope of 66 feet,* and a tackle consisting of one double and one single or snatch 12-inch block rove with a half coil of 4-inch white rope. The double block is secured at the head of the sheers, and the single block to one end of the wire guy, of which the other end is made fast to the chain of the anchor holdfast (established say 150 feet from the feet of the sheers).

The running end of the guy tackle leads off from the double block at the head of the sheers through a 12-inch snatch block secured to the foot of one of the spars, and thence to a crab capstan by which the guy is worked.

CONSTRUCTION OF HOLDFASTS AND FOOTINGS FOR SHOES.

Before deciding on the exact spot on which to erect sheers, the ground should be carefully examined, with a view to securing—

1st. A stable foundation for the feet.

2nd. Natural or existing holdfasts if possible, or failing that, ground suitable for making them.

Both back and fore guy holdfasts must be placed in the same vertical plane as the head of the sheers.

The back guy holdfast should never be less than twice the length of the spars from the feet, unless established on ground higher than they are.

With an anchor holdfast for the fore guy, it is better somewhat farther off (say 150 feet from the feet), this gives the anchors a better chance of holding.

The shoes are sometimes countersunk flush with the surface of

* Some 10 fathoms of $\frac{3}{4}$ -inch iron chain, with ring at end and shackle, could be made use of with advantage for the first length next the anchor holdfast for the fore guy, and the three lengths of wire guy be shackled on to it. This would give 60 feet of chain, 66 feet of wire rope, and 24 feet tackle. Unless some arrangement of this sort was made, half a coil would be too short for the fore guy, a whole coil would be required, and then the tackle would be in the water. The anchor holdfast could not be well brought closer in without risk of the anchors being lifted; the higher the sheers are placed over the spot where the anchors are bedded, the further off should the latter be.

Sheers.

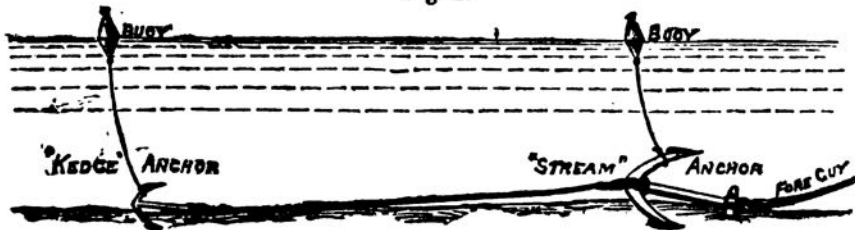
Section III.

the quay or pier; sometimes merely placed on the pier, being prevented from moving when the sheers are heeled *outwards* by the foot tackles (and, with fore guy "*anchor*" holdfast, heeling *inwards* should be avoided; the sheers in disembarking a gun, being merely brought perpendicular, when, should it be required to lower the weight still further inboard, it may be swung inwards by a rope or tackle, and lowered on to its carriage or platform wagon).

Should it be desirable to distribute the weight of the sheers, a "cross decked" platform of long broad planks should be placed under each shoe.

The heaviest anchors procurable should be made use of, if means are available for laying them out. As a rule, at least two anchors should be employed, such as one large or "*stream*" anchor, backed by a small or "*kedg*" anchor, Fig. 1.

Fig. 1.



Each anchor should have a 7' handspike lashed to its stock. Fig. 2, to prevent its falling on its side, and so failing to take hold, and should be buoyed, *vide* Fig. 1.

Fig. 2.

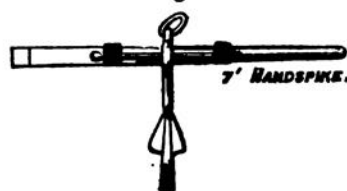
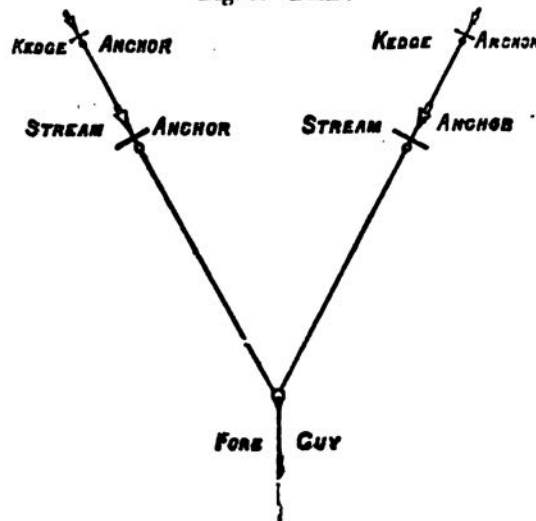


Fig. 3.—PLAN.



Section III.

Sheers.

Two stream anchors, backed by two kedge anchors, and laid out as in Fig. 3. will stand a great strain. The spot where each anchor is to be let go should be carefully buoyed beforehand.

Having laid out the anchor holdfast, it should be subjected to a strain with a capstan to make the anchors take hold, and to test its stability.

N.B.—Existing holdfasts should be well examined before use.

The nature of the ground will determine the construction of the back guy holdfast.

If good holding ground, a beam and picket holdfast would answer well, Fig. 6.

Fig. 6.

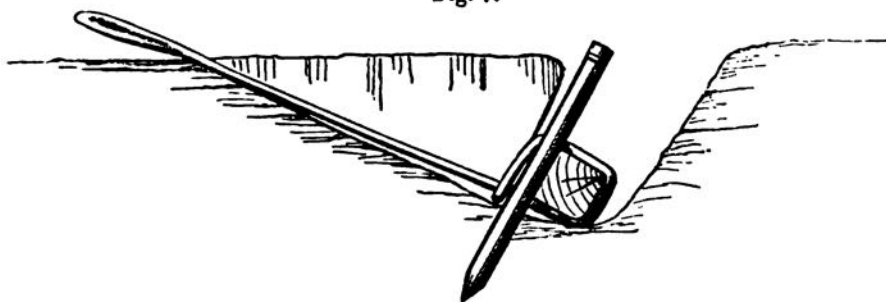


This would consist of a stout skid 12 or 14 feet long, with six or eight 5-foot pickets in front, with their heads lashed back to a like number in rear.

A stout strap or chain is passed round the centre of the beam into which the standing block of the back guy is hooked.

If not good holding ground, but capable of being excavated, the beam would be sunk in a four-foot deep trench, Fig. 7.

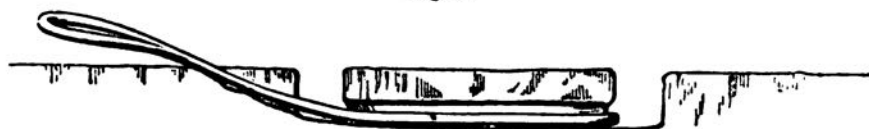
Fig. 7.



A row of pickets driven in front of the beam, round which a chain or strap is passed up a groove cut in the ground, to receive the standing block of the guy tackle. The earth is filled in over the beam to keep it from rising.

Where soft but sound rock occurs, a bellard may be cut for the holdfast, Fig. 8.

Fig. 8.

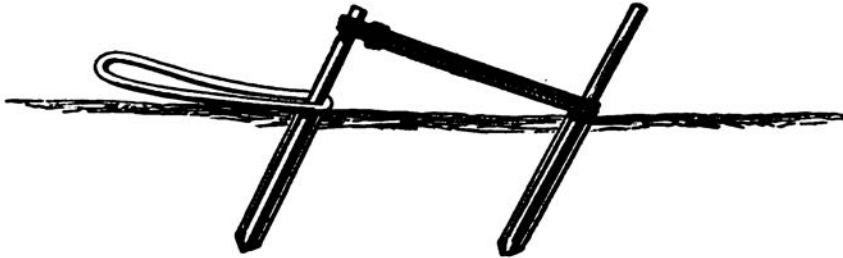


Sheers.

Section III.

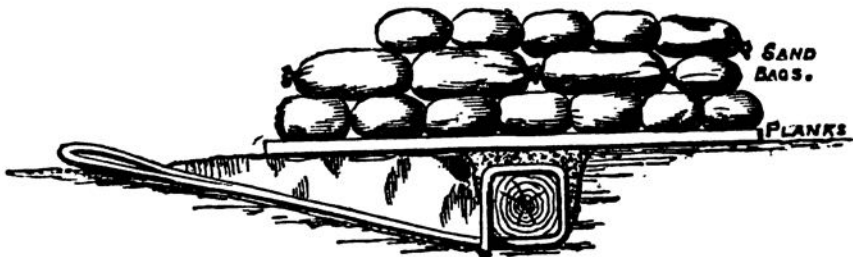
Where the rock is very hard holes about 18 inches deep may be "jumped" into which stout iron $1\frac{1}{2}$ -inch or 2-inch bars are inserted and wedged with slips of wood, Fig. 9.

Fig. 9.



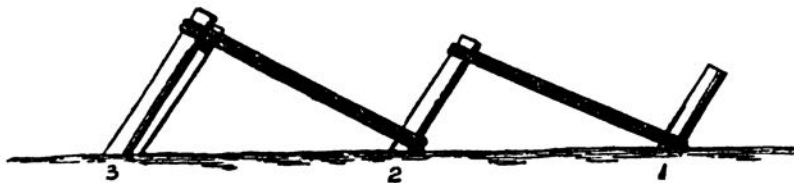
In cases where there is a shallow depth of soil overlying disintegrated rock, too hard to be excavated, yet not tenacious enough for either of the two last methods to be adopted, the best plan is to excavate down to the rock and place a beam in the trench so made; place a strap round it, to hook into, and keep the beam from rising by placing a platform of planks over it, well weighted down with earth and sand bags. As long as the beam is kept from rising it will afford good powers of resistance, Fig. 10.

Fig. 10.



For the capstans, in good holding ground, the ordinary 3, 2, 1, picket holdfast will suffice, Fig. 11.

Fig. 11.



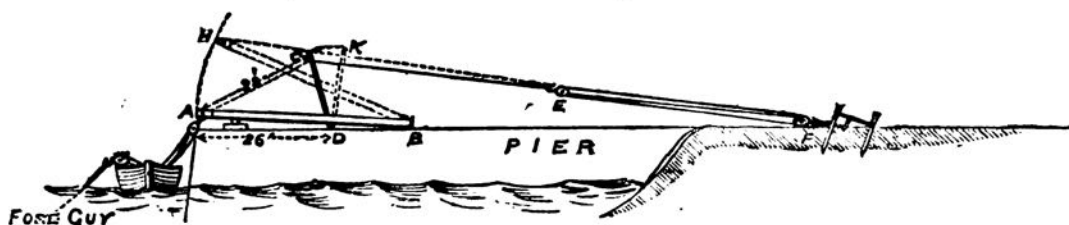
If there should be difficulty in constructing this, then one of the methods previously described must be resorted to.

Section III.

Sheers.

RAISING THE SHEERS BY LEVER ATTACHED TO BACK GUY.

Fig. 4.



- F, Back guy holdfast.
 A, Head of sheers skidded up at end of pier.
 B, Feet of sheers secured by foot tackles.
 DC, 14-foot lever, the point for lashing C 13 feet from the butt D.
 ACEF, Back guy, viz., ACE wire rope, and EF guy tackle.
 DK, Position of lever when it ceases to act in raising the sheers.
 BH, Position of sheers when lever ceases to act.

TO RAISE THE SHEERS WITH 14-FOOT LEVER SECURED TO BACK GUY.

The small end of the lever is placed in contact with the shackle which connects the first length of wire rope AC with the second and third lengths CE, and is strongly lashed with $1\frac{1}{2}$ -foot lashing to the eye at the end of the first length at C, and a collar of rope is made fast close below the lashing to keep it from slipping down the lever. The butt or point of the lever is placed midway between the sheer spars at D, and kept from slipping by foot ropes. The head of the lever is fitted with light side guys, secured at points, on either side, in the same line as the butt. The slack of the sheer foot tackles is taken in and the falls are made fast. On walking round on the back guy capstan the lever rises into the position DC, from which position it begins to raise the head of the sheers, and continues doing so until it reaches DK (the sheers being then at BH) when it goes out of bearing, and hangs suspended from the back guy. The sheers are now well under the unaided control of their own back guy, by which the operation of raising is completed. The fore guy tackle should, if possible, be kept out of the water during the operation, and carefully attended to, so as to keep the sheers well in hand as they approach the perpendicular.

ANOTHER METHOD OF RAISING THE SHEERS.

The method of raising by a single derrick is a very good one, and may be briefly described as follows;—

Strongly lash the lower block of the main tackle to one of the sheer spars near the foot with $2\frac{1}{2}$ -inch lashing. For the derrick select a light spar about 25 feet long, and rig it as follows:—

Sheers.

Section III.

Fig. 5.



Place the bight of a selvagee or strap in a slot previously cut in the head of the spar, Fig. 5, secure by lashing, and into the two bights, *a, a*, hook a 12-inch snatch block and securely lash another 12-inch snatch block to the foot of the spar.

Place the derrick with its head, skidded up, midway between the feet of the sheers, and its butt towards their head. Lead the running end of the main tackle fall from the upper block, through the 12-inch snatch block at the head of the derrick, thence through the 12-inch snatch block at its foot, and from there to the main tackle crab capstan. The derrick must be furnished with foot ropes or foot tackle (shoe if necessary), side guys, and a back guy, which may consist of a $4\frac{1}{2}$ -inch parbuckle rope with its hook lashed to the head of the derrick, the other end being taken to the back guy holdfast.

Make fast sheer and derrick foot tackles and the side guys of the latter. Walk round on the main tackle capstan, and the derrick will rise easily if its head be held up to give it a start. When it is nearly perpendicular make fast its back guy.

Continue walking round on the capstan, and the sheers will rise till high enough to be under the control of their own back guy, by means of which the raising is completed, the derrick being struck by walking back on the main tackle capstan.

The fore guy must be carefully attended to throughout the operation to keep the sheers well in hand, especially as they approach the perpendicular.

The sheers having been raised with the back guy, are moved to the front into the required position, as follows:—

Lash a spar, with stout square lashing, across the sheer spars close to the ground; raise one foot at a time, and place a plank (*oak* if procurable) underneath, lying fore and aft. Make fast tackles to haul the feet forward, and have a check rope on each in rear; water the planks, heave on the tackles, assisting with 7-foot handspikes applied as levers second order underneath the cross spar. The fore guy being taken in, and the back guy eased off as the sheers are moved to the front.

The head of the sheers should throughout have a slight inclination inwards to facilitate shifting the feet.

On arriving at the required position the feet are lifted into the shoes and the sheers are ready for work.

N.B.—Tarred cordage would be preferable to white if the sheers were likely to be up for any length of time. Great care should be taken, if white cordage is used, to keep it out of the salt water.

In some instances it may be possible to employ gyn sheers with lengthened prypole for disembarking siege guns, as when the sides of the pier are vertical and the feet can be planted right on the edge of the pier; but even then, the heel being limited, the weight cannot be picked up far out.

Section IV.

Platforms.

Section IV.—Platforms.

The platforms used for siege purposes are:—

1. Clerk's platform for use with 25-pr., 40-pr., and 6·3-inch howitzer.
2. Ordinary ground platforms for 64-pr. and 8-inch howitzer.
3. Special ground platforms, 6·3-inch and 8-inch howitzer on bed.

1. CLERK'S PLATFORM.

Clerk's platforms are carried and laid by the Royal Artillery.

Each consists of—

Two inclined planes, *a a'* (*vide sketch*), $17' \times 12''$, with a slope of 3° , and iron pins to pivot them to the front transoms. Two front transoms (*b b'*), each $7' \times 16'' \times 4''$, to which the inclined planes are pivotted. One centre transom (*c*) $7' \times 16'' \times 4''$. One rear transom (*d*) $10' \times 16'' \times 4''$. One trail plank (*g*) $8' \times 16'' \times 4''$, shod with iron. Two front stops. Two rear stops.

The platform weighs about 14 cwt.

*Entrenching Tools, &c., required:—*4 picks, 2 spades, 4 shovels, 2 rammers, 4 banderols or pickets, 1 maul, 1 field level or quadrant, 1 measuring tape.

The line of fire (*l f*) having been ascertained, and marked by pickets or banderols, the front transom (*b*) is laid at right angles to it, in the centre of the gun portion 6 inches from foot of the interior slope of the parapet; this is done by making the distances *ef*, *e' f*, from ends of the transom to any point *f* in the line of fire equal. The transom should be flush with the ground, and laid horizontal by aid of a field level.

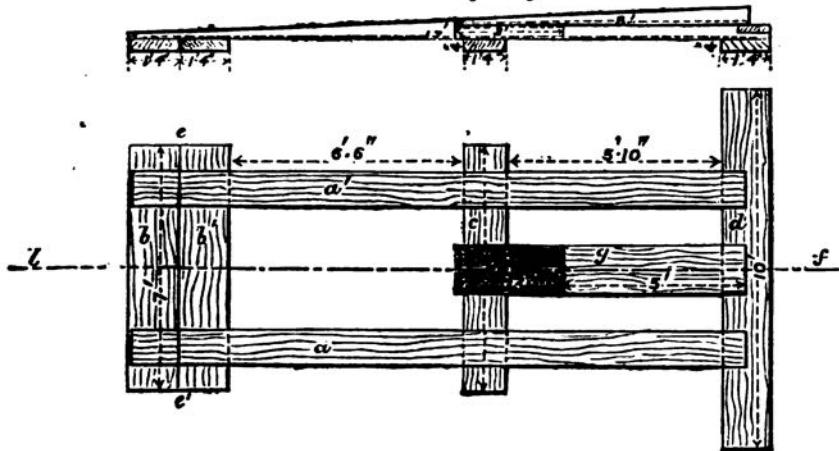
A second front transom (*b'*) is then laid in rear of and close to the first, after which the centre and rear transoms in succession, each being carefully levelled with regard to the others.

The front of the centre transom should be $6' 6''$ from the rear of the front ones. The rear transom at such distance from the front, that the ends of the inclined planes will rest on them sufficiently to admit of being traversed with handspikes bearing on the top of the transom.

Platforms.

Section IV.

CLERK'S PLATFORM.

Section through l f.

The ground between the transoms having been well rammed, the side pieces are laid ribands *inside*, and pivotted to the inner holes in the front transom by means of two iron pins.

Iron stops are then fitted on the front ends of the side pieces to prevent the gun being run up too far.

Similar stops on the rear ends to check recoil.

The trail plank is then placed between the side pieces, the iron shod portion of it to the front, and resting on the centre transom.

The line of fire should then be marked in the centre of the platform, either by means of a light batten 7 feet long, with pencil line down the centre, and secured in the ground by long nails, or by means of a piece of fine cord chalked and secured in a similar manner. In either case, batten or cord, indicating the line of fire, should be slightly above and independent of the transoms to prevent its shifting on the shock of discharge.

The easiest mode of mounting the gun is to remove the rear stops from the inclined planes, and run the gun up from the rear on an incline of quoins or skidding with planks on them.

2. GROUND PLATFORMS.

Ordinary ground platforms will be carried and generally laid by the Royal Engineers.

They consist either of two layers of 3 or 4½-inch deal planks placed crosswise, with ribands or eye-bolt screws.

Or of one layer of planks, supported on five 6" × 6" sleepers, held down by eye-bolt or coach screws, with or without ribands.

Both platforms are fitted with a hurter 9" × 9", and are 18 feet long by 12 feet wide.

The line of fire having been ascertained, the hurter is laid at right angles to it, close to the foot of the parapet.

The ground in rear is levelled to the required slope, about 3°.

Section IV.

Platforms.

Where two layers of planks are used, the lower one is then laid at right angles to the hurter.

The upper layer is laid at right angles to the lower, and is secured by eye bolt screws to the outer planks of the lower layer.

The front plank should be close up to the hurter.

The ribands are then placed and secured by eye-bolt screws.

Where sleepers are used, the hurter having been placed in position as before, and the ground in rear brought to the slope required, the five sleepers are laid at right angles to the hurter, and carefully levelled both with regard to each other and to the slope required.

The planks are laid at right angles to the sleepers, and secured by screws to the outer ones.

The ribands are then bolted to the ends of the upper planks.

In both cases an iron shod trail plank should be placed for the point of the trail to rest on.

The line of fire for the hanging scales is marked by a chalk line or piece of cord.

3. SPECIAL GROUND PLATFORM FOR 6.3-INCH AND 8-INCH HOWITZER ON BED.

This platform is of oak, and consists of—

Two side baulks, *a, a*.

Two centre baulks, *c, c*.

One front transom, *f*.

One connecting plate, *e*.

One rear transom, *r*.

The side baulks are dovetailed and bolted to the transoms, the centre baulks being housed into the same.

The front transom is fitted with a pivot *p* for the attachment of the guide bar of the howitzer bed. The pivot and the four bolts which secure it pass through the front transom, and are fastened on the lower side by keys.

The portion of the platform occupied by the howitzer bed, when in position for firing, is plated with sheet iron to protect it from the wear of the bed rollers, and a ground plate is let into the rear transom to facilitate traversing of the guide bar by hand-spikes.

The outer ends of the transoms are hooped to prevent them from splitting.

The platform will allow of the howitzer bed being traversed 5° to right or left of the centre.

Entrenching Tools, &c., required:—4 picks, 2 spades, 4 shovels, 2 rammers, 4 banderols or pickets, 1 maul, 1 field level or quadrant, 1 measuring tape, 1 turncrew (special), six 5-foot pickets.

The pivot bolt of the front transom having been keyed to it, and the two bolts, *b, b* (by which it is secured to the side baulks), passed through from the lower side, the transom is sunk its own

Platforms.

Section IV.

depth in the ground at right angles to the line of fire, and at such distance from the crest of the parapet as to admit of a minimum angle of elevation of 20° being given, unless a cut is made in inner edge of parapet. It is then levelled.

The rear transom is similarly placed at the requisite distance from the front, and the ground between them levelled and excavated to the depth necessary to lay the side and centre baulks flush with the ground.

The connecting plate having been placed half way between the transoms, the side baulks are laid and secured front and rear by the transom bolts, and to each other by the connecting plate.

The transom bolts are fitted with washers and screw nuts, which should be screwed down flush with the upper surface of the platform.

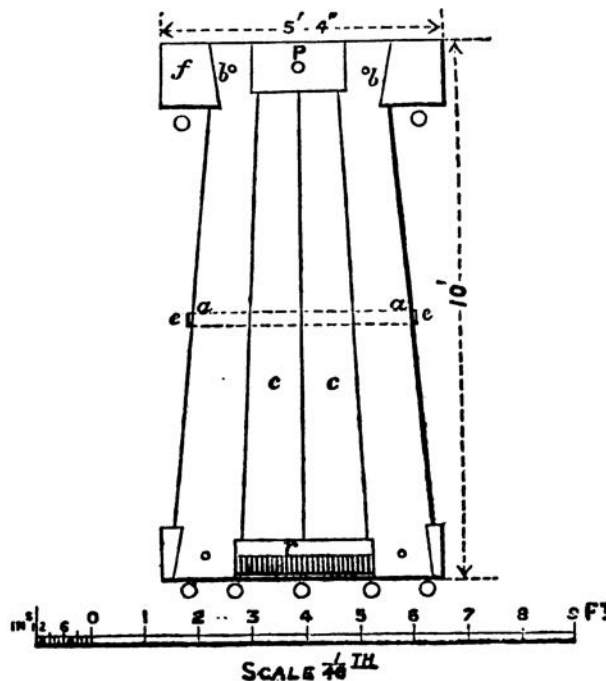
The connecting plate is secured by screw bolts to the outer sides of the baulks (at *e, e*). The ground between the latter having been well rammed, the two centre baulks are then laid.

To prevent the platform moving to the rear, 5-foot pickets should be driven at the rear of the transoms.

The howitzer, which would be conveyed on its bed by means of transporting axle, wheels, and limber, is run over the centre of the platform.

The limber, wheels, and axle are removed in succession, and the guide bar of the howitzer bed pivotted to the front transom bolt.

SIEGE PLATFORM FOR 6.3-INCH AND 8-INCH HOWITZER ON BED.



Section V.

Arming Siege Batteries by Night.

Section V.—Arming Siege Batteries by Night.

Before arming batteries by night, it is essential that the Officer charged with the carrying out of the operations should satisfy himself on the following points and take the following precautions:—

1st. That the roads, or lines of communication between the gun park and various gun emplacements, are practicable.

2nd. That those on whom will devolve the conducting the teams have made themselves thoroughly acquainted with the line of road they are to follow, especially with regard to any difficulties they may have to overcome *en route* to the different gun portions.

3rd. To arrange for the more difficult portions of the road being marked with patches of white along the side, to enable the drivers to keep the track after dark.

4th. That all preparations are completed before moving off to the trenches.

5th. That Officers concerned are furnished with distinct orders, in writing, as to the hour they are to move off, the order of succession of the different carriages, &c., the route they are to follow, both going and returning, the particular gun portion each piece is to occupy, and the arrangements to be carried out regarding the stowage of the ammunition, and finally, *that they understand their orders.*

6th. That those in charge of teams be clearly instructed as to the way in which the teams have been allotted, and that they have, before dark, satisfied themselves as to the exact position of the several carriages to be horsed.

7th. That the plan of operations be carefully considered beforehand and every precaution taken to guard against confusion or a block on the road, and for the speedy extrication of guns or carriages that may be in difficulties.

8th. That arrangements should if possible be made for teams returning by a different route.

9th. That it be impressed on all that noise or the flashing of lights would be liable to draw the enemy's fire and should therefore, as far as possible, be avoided.

It is more than likely that, in any future sieges of importance, light tramways of narrow gauge will be laid to connect the various magazines, gun parks, and depôts with the parallels and batteries of attack, and that such will be largely, if not exclusively, employed for the transport not only of ammunition and material but also of siege guns on their carriages, platforms, &c., and also to convey the reliefs to and from the trenches and batteries.

Arming Siege Batteries by Night.

Section V.**GENERAL REMARKS ON PLACING GUNS IN POSITION.**

Guns mounted on siege carriages will, if the nature of the approaches permit, be placed in their firing trunnion holes in the park, or before being moved into the battery. The road or passage which leads into the battery or gun position should be carefully examined, and any soft places or ruts should be covered with brushwood, sand bags, or planks. In any case weights over 40 cwt. ought not to be moved over any but the best ground unsupported, for if the wheels of a gun carriage or wagon sink in a narrow cutting, a great deal of time and labour will be expended in extricating it, besides blocking up the passage.

In lowering guns or wagons down sharp inclines, two drag ropes made fast to the tires of the wheels and a round turn taken through the trail handles will be found to act as an efficient brake. They can be shifted as required by scotching the wheels or removing one at a time.

It sometimes happens that in very soft ground, when using wheel purchases, the wheels will skid round without moving the weight; a drag-rope or piece of lashing woolded round the tires will prevent, this by causing the wheel to bite in the ground.

Section VI.

Drill, 25-pr. 40-pr. 6'3-inch Howitzer.

Section VI.—Drill for 25-pr. and 40-pr. R.M.L. Guns and
6'3-inch R.M.L. Howitzers on Travelling Siege Carriages
on Clerk's Platforms.

The detachment consists of 9 Nos., and falls in two deep. It is told off, marched into the battery, and halted in line, facing the parapet and to the left rear of the platform. It is now in the position of "detachment rear."

TO TAKE POST UNDER COVER.*

<i>Officer.</i>	<i>No. 1.</i>
<i>Take post under cover.</i>	<i>Right turn. Double march.</i>

The detachment wheels to its left, the front rank filing to the left of the gun, the rear rank to the right; 2 and 3 halt close to the parapet on the right and left of the platform: 4 and 5 form up on their right and left, and the whole turn to the right about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 go to the cartridge store; 7 and 9 to the shell store.

GENERAL DUTIES.

No. 1 commands, directs or superintends boring and fixing fuzes, assists to run up, and lays.

No. 2 searches, sponges, rams home, runs up, and traverses.

No. 3 loads, uncaps or removes safety pin from fuze when in bore, rams home, runs up, and traverses.

No. 4 attends to side arms and supplies them to 2, runs up, and elevates.

No. 5 attends to vent, runs up, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes and brings up projectiles.

No. 8 attends to cartridge store, and serves out cartridges to 6.

No. 9 attends to shell store, issues shells, tubes, and fuzes.

* If the gun is not behind a parapet and the word of command is "*Take post at the gun*," the detachment wheels to its left as before, 2 and 3 halt in line with the front of the wheels; 4 and 5 with the rear of the wheels, No. 1 in rear of the gun, 6, 7, 8, 9 at the limber.

Drill, 25-pr. 40-pr. 6.3-inch Howitzer.

Section VI.

TO PREPARE FOR ACTION.

*Officer.**Prepare for Action.**No. 1.**Prepare for action.
Examine gun.*

"Prepare for action."—The stores are brought up as follows:

No. 1, handspike and sights.

No. 2, handspike, and assists 4 with side arms.

No. 3, handspike, removes the tampeon from the muzzle.

No. 4, handspike, side arms, and support for head of side arms.

No. 5, handspike, tubes in pocket, lanyard, pricker and vent server.

No. 6, two cartridge cases, which he leaves at the cartridge store, bucket filled, and brush. For drill purposes two drill cartridges.

No. 7, fuzes and fuze and shell implements. He obtains the fuze boxes from 9, having ascertained from No. 1 the fuzes required; and satisfies himself as to the correctness of fuzes and fuze implements. He places the fuze boxes on the shell benches in the covered way on left of gun portion where the shells are fuzed.

No. 8 prepares to issue cartridges.

No. 9 provides a brush, prepares to issue shells, friction tubes, and fuzes. He examines the shells carefully, cleaning them if necessary and removing burrs from studs; he loosens the fuze-hole plugs of shells that will be first issued and sees that the gas-checks are properly fitted.

The stores having been brought up, No. 1 will satisfy himself that the fore sights fit properly on the gun and the deflection leaves of the hind sights work easily; he receives the reports from the Nos. responsible of any irregularity or deficiency in connection with the gun, ammunition, or stores.

The sponge, rammer, and wadhook are laid on the ground clear of the platform, to the right of the gun and parallel to it, heads to the rear, resting on the support supplied by 4, sponge nearest the gun.

The sponge bucket near the sponge head.

The handspikes are laid down, two on each side of the gun close to the carriage, points to the front, bevelled side uppermost, those of 2 and 3 outside, and about two feet in advance of those of 4 and 5. No. 1's handspike in rear of the platform.

No. 3 examines the bore to see the grooves are free from grit, &c.

No. 4 ascertains that the elevating gear is in working order (should the elevating arc have been detached from the carriage he brings it up and adjusts it).

No. 5 straps the tube pocket round his waist on the right side, coils up the lanyard, and passes the bight of it through the tube pocket strap; examines the vent server, and places it in the vent,

Section VI.

Drill, 25-pr. 40-pr. 6'3-inch Howitzer.

the loop of the vent server lanyard over one of the sights; he fills his tube pocket with friction tubes which he procures from 9, and places the pricker in the loop on the carriage.

N.B.—Should the stores be on the gun, they are unstrapped and laid down as above detailed.

“Examine gun.”—No. 5 drifts the vent, replaces the pricker in the loop and the vent server. 2 supplies himself with the wad-hook, searches the gun after the pricker has been withdrawn, and replaces wadhook. 4 attends to the elevating wheel to bring the gun into a convenient position for loading.

TO LOAD.

<i>Officer.</i>	<i>No. 1</i>
<i>Range</i> —yards.	<i>With</i> —load.
<i>With</i> —load.	

“Load.”—No. 1 gives 7 the nature of shell and fuze required, and during the loading fixes his tangent scale at the required elevation. He places himself in a convenient position, near the muzzle, whence he can watch the loading and observe, by the mark on the rammer, if the shell is home.

No. 2 places himself in a convenient position for sponging. He places his left foot in line with and about 12 inches from the muzzle, steps to his right with his right foot, and looks to his left rear, takes the sponge in a horizontal position from 4, left hand back down, right hand back up, brings it in line with the axis of the gun, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half turns, pressing it against the bottom of the bore, withdraws the sponge, hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle, he jerks it out, his hands then should be in the position they were in when he introduced the sponge into the bore. He then hands the sponge to 4 and receives the rammer, right hand about the centre back down, left as near the head as possible back up; as soon as the cartridge and shell are put in, he enters the head into the bore and forces them home hand over hand. He then springs the rammer, steps out, hands it to 4 and goes under cover.

No. 3, as soon as the sponge is withdrawn, takes the cartridge from the cartridge case with his left hand, moves up and places it in the bore; he then slews his body to his right and receives a shell from 7 and puts it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2 and assists him to ram home; when the cartridge and projectile are home he quits the stave and goes under cover.

No. 4 doubles out, halts in line with the sponge head, turns to

Drill, 25-pr. 40-pr. 6.3-inch Howitzer.

Section VI.

his left, picks up the stave with his right hand back under, 6 inches from the head, turns three-quarters left about, and in doing so lifts the sponge over his head, allowing the end of the stave to rest on the ground. His left hand meets the stave close to the sponge, his right hand is slipped up the stave about two feet. He then moves towards the muzzle and places the sponge in a convenient position for 2 to lay hold of, waiting for its return at the left rear of 2 facing the gun. When he receives the sponge from 2 he allows the end of the stave to fall on the platform, steps to his left, turns three-quarters right about, passing the sponge over his head, lays it down, takes up the rammer as before detailed for the sponge and hands it to 2. He then remains in position to receive the rammer as soon as 2 has sprung it. He lays it down as he did the sponge and goes under cover.

No. 6 brings up a cartridge in a case and places it on the ground on 3's right front; after the sponge is withdrawn he uncovers it, and as soon as 3 has withdrawn the cartridge, 6 takes the case back to the cartridge store.

No. 7 brings up a shell point to his right, having fixed the fuze according to No. 1's direction, and hands it to 3.

No. 8 issues a cartridge to 6.

No. 9 issues a shell to 7.

TO RUN UP.

Directly the gun is loaded, No. 1 gives "*Run up*," and applies his handspike at the trail eye to guide the gun.

Nos. 2, 3, 4, 5 take up their handspikes; 2 and 3 apply theirs horizontally over the spokes of the wheels in front, and under the bracket, close to the breast, and bear down; 4 and 5 use theirs as levers of the second order under the rear part of the wheels. All four numbers face to the rear.*

When the gun is run up, No. 1 gives "*Halt*," slides his handspike to the rear clear of the recoil, and looks over the sights, steadying himself by leaning on the cascable. 2 and 3 go to the end of the trail facing to the rear ready to traverse, 4 and 5 lay down their handspikes, 4 goes to the elevating wheel, 5 prepares a tube.

TO LAY THE GUN.

Officer.

No. 1.

Elevate.
Depress.
Halt.
Trail right.
Trail left.
Halt.

* Running back at Drill is the converse of the preceding.

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Drill, 25-pr. 40-pr. 6.3-inch Howitzer.

At "*Elevate*" or "*Depress*," 4 turns the wheel in the required direction till the word "*Halt*."

At "*Trail right*," 3 heaves over the trail, at "*Trail left*" 2, till the word "*Halt*."

At "*Extreme right or left*," 2 and 3 apply their handspikes and with 4 and 5 heave over the inclined planes, drawing out the iron bolts in the rear for the purpose; when it is necessary to shift the trail plank, 2 and 3, using the side pieces as fulcrums, place the points of their handspikes under the trail handles and then raise the trail; 4 double man's 2's handspike, 1 and 5 shift the plank.

If it is necessary to run the gun back, at "*Run back*" 2 and 3 apply their handspikes in front of the wheels, using them as levers of the second order: 4 and 5 take a purchase with theirs over the most horizontal spokes in rear and under the brackets; the whole facing to the rear.

Should no order to fire be given, when the gun is laid, No. 1 gives the order "*Under cover*."

TO MAKE READY AND FIRE.

<i>Officer.</i>		<i>No. 1.</i>
<i>Fire</i> — <i>rounds.</i>	|	<i>No.</i> — <i>Ready.</i>
		<i>No.</i> — <i>Fire.</i>

No. 1 lowers his tangent scale, except when firing at a moving object, and gives "*Ready*;" 5 presses the tube into the vent with his right thumb, steps clear of the recoil, shifts the lanyard to his right hand and extends it, keeping his hand level with the vent, facing the gun.

As soon as "*Ready*" is given, 2 and 3 lay down their handspikes and with 4 go under cover.

At "*Fire*" 5 draws the lanyard strongly towards his body, without a jerk; he then drifts the vent, replaces the vent server and goes under cover.

No. 1 does not again give "*Load*" until 5 has replaced the vent server.

GUNS ON OVERBANK CARRIAGES.

The services of the guns is the same as that just detailed, with the following exceptions:

The gun is run up till the muzzle is three or four feet from the parapet to load: 3 then depresses the muzzle (by means of the elevating wheel which is in front of the carriage) till it is about a foot below the interior crest.

Drill, 25-pr. 40-pr. 6·3-inch and 8-inch Howitzer.

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A wire rope sponge and jointed rammer stave are used. The sponging is performed in the ordinary manner. The rammer is handed to 2 folded up. It is passed into the bore one length at a time, the second length being straightened out and the collar slipped over the joint when the end of the first length reaches the muzzle, and so on. Withdrawing it is the converse of the above.

The rammer should be turned in entering and withdrawing it, so as to allow the portion of it outside the bore to hang downwards.

Before finally withdrawing the rammer, 2 must ascertain if the shell shows any tendency to slip forward, and if it does so, he keeps a steady pressure on the rammer while 3 elevates till the muzzle of the gun is nearly in line with the interior crest. The rammer is then withdrawn, and 3 elevates till the axis of the gun is about 3° elevation.

The gun is then run up.

In laying, No. 1 stands on the trail. He must carefully note that the trail plank under the point of the trail is well supported. If it is not, the removal of his weight from the trail after he has finished laying will cause the trail to rise and the muzzle to be depressed. The shooting would therefore be inaccurate.

64-PR. R.M.L. GUN ON TRAVELLING SIEGE OR OVERBANK CARRIAGE.

This gun will usually be mounted on a ground platform.

To check the recoil, "check chains" are provided. They are secured to the felloes of the wheels between the two lower spokes and to a wire rope strap which is passed through the trail eye. Care must be taken that the chains are at an equal tension, and that the leather pads bear on the inside of the felloes. The chains are cast loose from the felloes before running up.

4 and 5 attend to them.

The remainder of the drill is the same as that of 40-pr. R.M.L. guns.

8-INCH R.M.L. HOWITZER ON TRAVELLING SIEGE CARRIAGE.

The drill for this howitzer is the same as that for the 64-pr. R.M.L. gun, with the following exceptions:—

Nos. 7 and 9 bring up the shell in a bearer. It is lifted up to the muzzle, and the base of the shell entered in the bore by 2, 3, 7, 9. 9 then takes the bearer back to the shell store.

Not more than 20° elevation to be given.

6·3-INCH AND 8-INCH R.M.L. HOWITZERS ON BEDS.

The drill is the same as for howitzers on travelling carriages with the following exceptions:—

The recoil is checked by means of an iron plate compressor. No. 1 sets the adjusting lever, with a view to obtaining as much recoil as possible and thus taking the strain off the pivot bolt.

(A. M.)

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Section VI.

Drill, 7-pr.

He must take care that the directing bar is central so that the compression on each side is equal when the compressor handle is put down.

5 attends to the compressor lever. He throws it up after recoil, and puts it down below the catch as soon as the howitzer is run up and before it is laid. It is liable to throw the howitzer out of line if put down after the latter is laid.

To run up.—4 hooks a drag-rope to the eye bolt in the breast transom. It is manned by 2, 3, 4 and 5 in the 6.3-inch howitzer, and by the whole detachment in the 8-inch howitzer. With the latter howitzer it will be found advantageous to use tackle instead of a drag-rope when possible.

To load.—The howitzers are loaded in the firing position.

To traverse.—2 and 3 are supplied with iron shod levers instead of handspikes. They apply them under the horns of the directing bar.

To lay.—The howitzer being mounted in rear of a high parapet, the object fired at cannot be seen over the sights. One of the methods of laying hereafter described must therefore be adopted.

Howitzers on beds not to be fired at less than 20° elevation on account of the strain on the pivot.

7-PR. R.M.L. GUN OF 200 LBS. ON BED.

The detachment consists of 5 Nos.

No. 1 commands, attends to vent, and lays.

No. 2 searches, sponges, rams home, and runs up.

No. 3 loads, uncaps fuze when in bore, traverses, runs up, makes ready, and fires.

No. 4 supplies 3 with ammunition and runs up.

No. 5 serves out ammunition, fixes fuzes, and runs up.

This gun is intended for use in the advanced trenches. It, together with its ammunition, will generally be brought up in a trench cart. It is lifted out of the cart by the detachment, and placed on the ground as close to the parapet as possible. The line is obtained by pointing rods on the parapet or in rear, and the elevation by clinometer. To check the recoil, pickets may be driven in rear of the transom. If more elevation is required than that allowed by the bed (22°), the stool bed should be removed, when elevation can be given up to 37°. To move the gun short distances along the trenches, 2, 3, 4, and 5 take hold of the handles and carry the gun on its bed.

Note.—If fired at an elevation less than 33° in the ordinary parallel, a special recess will have to be cut in the reverse slope to enable the bed to be set back sufficiently for the line of fire to clear the parapet.

The same measure would have to be adopted in the advanced sap if the gun is to be fired at elevations below 40°.

Unlimbering and Shifts, 25-pr.

Section VII.

Section VII.—R.M.L. Ordnance on Travelling Siege Carriages.

TO UNLIMBER.

This must be done when the gun is in the firing trunnion holes.

<u>Officer.</u>	<u>No. 1.</u>
<i>Unlimber.</i>	<i>Prepare to unlimber.</i>
	<i>Lift.</i>
	<i>Limber drive on.</i>
	<i>Lower.</i>

"*Prepare to unlimber.*"—No. 1 unkeys the keep chain, and with 2, 3, 4, 5, 6 and 7 stands to the trail, 2 and 3 nearest the gun. If there are no horses 9 goes to the shafts and 8 to the splinter bar on the near side.

At "*Lift*" the trail is lifted clear of the pintail; at "*Limber drive on*" the limber moves on, and at "*Lower*" the trail is lowered to the ground.

TO LIMBER-UP.

<u>Officer.</u>	<u>No. 1.</u>
<i>Limber-up.</i>	<i>Prepare to limber-up.</i>
	<i>Lift.</i>

The several numbers place themselves as for unlimbering, and at "*Lift*" lift the trail on to the pintail, No. 1 keys up.

When unlimbering or limbering-up guns mounted on overbank carriages, great care should be taken *not to raise the trail too high*, as it is apt to fly up and escape from the control of the men lifting it, in which case the gun pitches violently over on to its muzzle, and may become dismounted.

SHIFTS.

TO SHIFT A 25-PR. R.M.L. GUN ON OVERBANK CARRIAGE FROM FIRING TO TRAVELLING TRUNNION HOLES.

This must be done while the gun is limbered-up.

Strength of Detachment.—This may be done with one gun detachment, but in shifting from travelling to firing trunnion holes it is advisable to employ two, as the work is heavy.

Section VII.

Shifts, 25-pr.

Stores required.—The stores required in addition to those on the gun are as follows, viz.:—

Drag-ropes, heavy	2
Luff tackles, complete	2
Key, crossed-handled, removing arcs	1

Officer.

*Shift from firing to travelling
trunnion holes.*

No. 1.

*Prepare to shift the gun.
Hook tackles.
Prepare to bear down.
Bear down.
Come up.
Prepare to lift.
Lift and heave.
Halt.
Lower.
Prepare to bear down.
Bear down.
Heave and ease off.
Cast off tackles.*

Prepare to shift the gun.—2, 3, 4 and 5 cast loose side arms, handspikes, remove elevating arc and cap squares; 4 scotches the wheels in front; 5 in rear. 8 and 9 lash trail-eye to axletree bed of limber with a drag rope.

Hook tackles.—No. 1 fixes cascable bar; 4 and 5 hook double blocks to it; 6 and 7 the single blocks to breast of carriage; 4 and 5 stand ready to ease off; 9 makes fast a drag-rope to the rear patch and passes it to the front to 8.

Prepare to bear down.—2 places a handspike in bore, makes fast a drag-rope to the end of it; 3 double mans; 6 hands roller to 1.

Bear down.—2 and 3 bear down; No. 1 places the roller.

Come up.—The breech is lowered on to the roller; 6, 7, 8 and 9 man the breech drag-rope; 2 and 3 stand ready for lifting; 4 and 5 to ease off.

Lift and heave.—2 and 3 lift the muzzle; 4 and 5 ease off; 6, 7, 8 and 9 haul on breech drag-rope until the trunnions are over the upper surfaces of the brackets, when No. 1 gives,

Halt. Lower.—The trunnions are lowered to bear on the flat part of the brackets.

Prepare to bear down.

Bear down.—2 and 3 bear down; No. 1 removes the roller.

Heave and ease off.—4 and 5 ease off; 6, 7, 8 and 9 heave on breech drag-rope; 2 and 3 steady the muzzle.

Cast off tackles.—The tackles are cast off by the same numbers that hooked them, the gun is secured by straps to the carriage for travelling.

Shifts, 25-pr. and 40-pr.

Section VII.

TO SHIFT FROM TRAVELLING TO FIRING TRUNNION HOLES

<u>Officer.</u>	<u>No. 1.</u>
<i>Shift from travelling to firing trunnion holes.</i>	<i>Prepare to shift the gun.</i> <i>Hook tackles.</i> <i>Arrange muzzle handspike.</i> <i>Taut. Heave.</i> <i>Cast off tackles.</i>

Prepare to shift the gun.—2, 3, 4 and 5 cast loose side arms, handspikes, &c.; 4 and 5 scotch the wheels as before.

Hook tackles. Arrange muzzle handspike.—2, 3, 4, 5, 6 and 7 as before; 9 makes fast a drag-rope to rear patch, takes a turn round the axletree bed of limber, and hands running end to 8; 5, 7 and 9 man the fall on the right of the gun; 4, 6 and 1 on left.

Taut. Heave.—4, 5, 6, 7, 9 and 1 heave the gun up until the trunnions are on the upper surface of the brackets of carriage, 2 and 3 steadying the muzzle as before; when 6 and 7 fall off and place the points of handspikes in the trunnion holes to receive the trunnions; 8 easing off carefully. As soon as the trunnions drop on to the handspikes, No. 1 gives,

Cast off tackles.—This is done by the numbers that hooked them; 6 and 7 working out their handspikes.

TO SHIFT A 40-PR. R.M.L. GUN, ON TRAVELLING SIEGE CARRIAGE, FROM TRAVELLING TO FIRING TRUNNION HOLES.

This must be done while the gun is limbered up.

Strength of Detachment.—One gun detachment.

<u>Officer.</u>	<u>No. 1.</u>
<i>Shift from travelling to firing trunnion holes.</i>	<i>Prepare to shift the gun.</i> <i>Prepare to bear down.</i> <i>Bear down.</i> <i>Come up.</i> <i>Prepare to lift.</i> <i>Lift and heave.</i> <i>Prepare to bear down.</i> <i>Bear down.</i> <i>Come up.</i>

Prepare to shift the gun.—2, 3, 4 and 5 cast loose side arms and handspikes, and unbuckle straps should the gun be so secured; 2 and 3 take off cap-squares; 4 and 5 scotch the gun wheels with handspikes; 4 in front; 5 in rear.

Prepare to bear down.—2 places his handspike in the bore; 4 passes a handspike across 2's to 5; 8 and 9 make fast two drag-ropes to the breech, and pass the ends towards the muzzle; 3, 8 and 9 then double man 2's handspike.

Section VII.

Shifts, 40-pr.

Bear down.—2, 3, 4, 5, 8 and 9 bear down; 6 hands the roller to No. 1, who places it as near as possible to the centre of gravity and gives,

Come up.

Prepare to lift.—4 crosses his handspike under that in the bore to 5; 1, 6 and 7 man the ropes.

Lift and heave.—The bends of the arms are placed under the handspikes; the gun is raised out of the travelling holes and hauled forward until the trunnions fall into the firing holes. The handspike men should keep their eyes fixed on the gun so as to be prepared for its descent. As soon as the gun is in the trunnion holes the drag-ropes are cast off by 8 and 9.

Prepare to bear down.—4 reverses his handspike, and places it over that of 2.

Bear down.—6 withdraws the roller, and straps it on the carriage; 1 and 7 put on the elevating gear.

Come up.—The handspikes are withdrawn and laid down.

TO SHIFT FROM FIRING TO TRAVELLING TRUNNION HOLES.

The operation of shifting from firing to travelling trunnion holes is the converse of the above, but the roller should be placed with its centre opposite the rear of the horns of the travelling trunnion holes. The breech can be raised with handspikes to enable the roller to be withdrawn. The gun is secured by straps to the carriage for travelling.

TO SHIFT A 40-PR. R.M.L. GUN ON OVERBANK CARRIAGE FROM FIRING TO TRAVELLING TRUNNION HOLES.

This must be done while the gun is limbered up.

Strength of Detachment.—About 19 Nos.; or, say, two gun detachments.

Stores required.—The stores required, in addition to those on the gun, are as follows, viz.:—

Drag-ropes, heavy	..	..	..	..	3
Luff tackles, complete	..	..	..	..	3
Selvagees ..	..	..	..	..	2
Key, cross-handled, removing arcs	..	..	..	..	1

The special gun roller, when in use, rests on two gudgeon plates fitted to the cheeks of the overbank or top carriage; when not in use the brackets fold down.

The cross-handled key is used for removing the keep pins of the bolts which secure the elevating arc in the patches.

Shifts, 40-pr.

Section VII.

<u>Officer.</u>	<u>No. 1.</u>
<i>Shift from firing to travelling trunnion holes.</i>	<i>Prepare to shift the gun.</i> <i>Hook tackles.</i> <i>Prepare to bear down.</i> <i>Bear down.</i> <i>Come up.</i> <i>Prepare to lift.</i> <i>Lift and heave.</i> <i>Halt. Lower.</i> <i>Prepare to bear down.</i> <i>Bear down.</i> <i>Heave and ease off.</i> <i>Cast off tackles.</i>
<p><i>Prepare to shift the gun.</i>—2, 3, 4 and 5 cast loose side-arms handspikes, remove elevating arc, fittings, &c.; 2 and 3 remove cap-squares; 4 scotches the wheels in front; 5 in rear; 8 and 9 lash trail-eye to axletree bed of limber with a drag-rope.</p> <p><i>Hook tackles.</i>—No. 1 places cascable bar on cascable; 4 and 5 hook the double blocks to it; 6 and 7 the single blocks to the eye bolts on breast of carriage; they take in the slack, and stand ready for easing off, assisted by 4 and 5; 9 hooks the double block of tackle to cascable; 8 the single to trail plate eye, using selvagees for this purpose, they take in the slack, and pass the fall to the front.</p> <p><i>Prepare to bear down.</i>—2 places a handspike in the bore, and makes fast a drag-rope to end of it; double manned by 3, 8 and 9; 6 hands roller to 1.</p> <p><i>Bear down.</i>—2, 3, 8 and 9 bear down. No. 1 places roller and gives, <i>Come up.</i></p> <p><i>Prepare to lift.</i>—All the numbers above 9 man the breech tackle.</p> <p><i>Lift and heave.</i>—2, 3, 8 and 9 lift; 4, 5, 6 and 7 ease off a little, the remainder haul on breech tackle until the trunnions are over the flat part of the brackets; when No. 1 gives <i>Halt, Lower</i>, 2, 3, 8 and 9 lower the trunnions on to the brackets, the breech-tackle Nos. easing off at the same time.</p> <p><i>Prepare to bear down.</i></p> <p><i>Bear down.</i>—No. 1 removes roller, and throws back catches.</p> <p><i>Heave and ease off.</i>—4, 5, 6 and 7 ease off; 2, 3, 8 and 9 steady the muzzle; remainder haul on breech tackle.</p> <p><i>Cast off tackles.</i>—The tackles are cast off by the same numbers that hooked them, the gun is secured by straps to the carriage for travelling.</p>	

TO SHIFT FROM TRAVELLING TO FIRING TRUNNION HOLES.

<u>Officer.</u>	<u>No. 1.</u>
<i>Shift from travelling to firing trunnion holes.</i>	<i>Prepare to shift the gun.</i> <i>Hook tackles.</i> <i>Arrange muzzle handspike.</i> <i>Taut. Heave.</i> <i>Cast off tackles.</i>

Section VII.

Shifts, 64-pr.

Prepare to shift the gun.—As before, 8 and 9 lash trail eye to axletree bed of limber with a drag rope.

Hook tackles.—As before.

Arrange muzzle handspike.—As before.

Taut. Heave.—2, 3, 8 and 9 steady the muzzle; 19 eases off check tackle, the remainder man the falls of the hauling tackles on their own sides; as soon as the trunnions rest on the flat part of the carriage brackets, 6 and 7 place points of handspikes in the trunnion holes to receive the gun.

Cast off tackles.—As before.

TO SHIFT 64-PR. R.M.L. ON A TRAVELLING SIEGE CARRIAGE
FROM FIRING TO TRAVELLING TRUNNION HOLES.

This must be done while the gun is limbered up.
Extra men or two detachments will be required.

Officer.

Shift the gun from firing to travelling trunnion holes.

No. 1.

Prepare to shift the gun.
Prepare to bear down.
Bear down.
Prepare to lift.
Lift.
Prepare to bear down.
Bear down.
Prepare to lift.
Lift and heave.
Come up—Scotch up.
Prepare to bear down.
Bear down.
Come up—Scotch up.
Prepare to lift.
Lift and heave.

"Prepare to shift the gun."—2, 3, 4 and 5 cast loose the side-arms and handspikes, 2 and 3 take off the capsquares, 4 and 5 scotch the wheels with the gun quoins.

"Prepare to bear down."—3 places his handspike in the bore, allowing the point to project about 18 inches; 2 places one across it to 3; 4 passes his handspike across the muzzle to 5; 8 and 9 make fast a drag-rope each to the cascable and pass them to the front; they then double man 2's and 3's handspike.

"Bear down."—The muzzle is borne down; Nos. 1 and 7 take off the elevating arc, and place it in the brackets for its support on the side of the carriage; 6 hands the shifting roller to No. 1, who places it as near as possible to the centre of gravity; 6 and 7 scotch up in rear of the roller; *"Come up."*

"Prepare to lift."—2 and 4 cross their handspikes under the gun to lift; 6 and 7 stand ready to place the points of handspikes in the trunnion holes.

Shifts, 64-pr.

Section VII.

"*Lift.*"—The gun is lifted until the points of the handspikes are in the trunnion holes.

"*Prepare to bear down.*"—As before detailed.

"*Bear down.*"—The roller is shifted close to the centre of gravity and scotched up in rear; "*Come up.*"

"*Prepare to lift.*"—As before, but 8 and 9 are no longer required to lift and go on the drag-ropes; 2 places his handspike in the bore under 3's.

"*Lift and heave.*"—The gun is lifted clear of the trunnion holes, and heaved to the front until the trunnions rest on the brackets of the carriage between the firing and travelling holes.

"*Come up.*" "*Scotch up.*"—6 and 7 scotch up in rear of the trunnions.

"*Prepare to bear down.*" "*Bear down.*"—The gun is borne down until the roller is clear, when No. 1 shifts the roller to the front, having the centre of it in line with the horns of the travelling holes. "*Come up.*" "*Scotch up.*"

"*Prepare to lift.*" "*Lift and heave.*"—The gun is lifted and heaved into the travelling holes.

The gun is again borne down; 6 removes the roller and straps it to the carriage; 2, 3, 4 and 5 replace handspikes.

The gun is secured by straps to the carriage for travelling.

TO SHIFT FROM TRAVELLING TO FIRING TRUNNION HOLES.

Is the converse of the above.

The roller is placed as near as possible to the centre of gravity, and the gun is received on the points of handspikes in the trunnion holes; 8 and 9 are required to lift at the muzzle. A check-rope should be used made fast to the cascable and the axletree bed of limber.

Note.—If a set of luff tackle is available it would be advisable to use it (made fast to the cascable and the axletree bed of the limber) instead of the drag-ropes, when shifting to travelling holes.

64-PR. R.M.L. GUN ON OVERBANK CARRIAGE.

To shift from firing to travelling holes, or the converse. These operations are performed limbered-up.

Strength of Detachment.

For these shifts it is advisable to employ a detachment of about 25 Nos., or say, three gun detachments, the work being very heavy with fewer men.

Section VII.

Shifts, 64-pr.

Handspikes, common, 6-ft.	..	..	..	5*
Ropes, drag, heavy	..	..	..	2*
Hammers, claw	..	..	..	1*
Key, cross-handled, removing arcs	..	..	..	1
Tackles, gun, heavy	..	..	..	3
Selvagees or lashings	..	..	..	2
Levers,† 12-ft.	..	..	..	1
Bar, iron, cascable..	..	..	..	1*
Rollers, gun (special)	..	..	..	1*

TO SHIFT FROM FIRING TO TRAVELLING TRUNNION HOLES.

<u>Officer.</u>	<u>No. 1.</u>
<i>Shift from firing to travelling trunnion holes.</i>	<i>Prepare to shift the gun.</i>
	<i>Hook tackles.</i>
	<i>Prepare to bear down.</i>
	<i>Bear down.</i>
	<i>Come up.</i>
	<i>Prepare to lift.</i>
	<i>Lift and heave.</i>
	<i>Lower.</i>
	<i>Prepare to bear down.</i>
	<i>Bear down.</i>
	<i>Come up.</i>
	<i>Prepare to lift.</i>
	<i>Lift and heave.</i>
	<i>Lower.</i>
	<i>Prepare to bear down.</i>
	<i>Bear down.</i>
	<i>On the breech tackle heave.</i>
	<i>Cast off tackles.</i>
	<i>Arrange stores.</i>

"*Prepare to shift the gun.*"—2, 3, 4 and 5 remove side arms, cap-squares and elevating arc; 8 and 9 lash the trail-eye with a drag-rope to the axletree bed of the limber, to guard against undue strain falling on the keep chain; 4 and 5 scotch the wheels, 4 in front, 5 in rear. No. 1 places the cascable bar through the breeching loop.

"*Hook tackles.*"—4 and 5 hook the treble blocks of the preventor tackles to the cascable bar; 6 and 7 the double blocks to the eye-bolts of the brackets; 8 and 9 make fast the breech tackle, 9 securing the treble block with a selvagee to the cascable; 8, the double block in like manner to the end of the trail.

* On the gun carriage.

† An 8-ft. lever may be used if a 12-ft. lever cannot be procured.

Shifts, 64-pr.

Section VII.

"Prepare to bear down."—2 and 3 place a 12-ft. lever in the bore, double manned by 8 and 9, who secure a heavy drag-rope with a clove hitch on the bight to the end of the lever; 4 passes a handspike to 5 over and across the lever near the muzzle, double manned by 10 and 11.

"Bear down."—The muzzle being borne down, 6 and 7 hand the gun roller to No. 1, who places it in the lower steps of the gudgeon plates.

"Come up."—The breech is allowed to rest on the roller.

"Prepare to lift."—The lever and handspike Nos. stand by to lift.

"Lift and heave."—The Nos. at the muzzle lift; the breech tackle Nos. (12, 13, 14 and 15, and all the higher Nos.) heave till the gun is high enough to enable 6 and 7 to place handspikes under the trunnions in each trunnion hole.

The gun is allowed to rest on the handspikes.

"Prepare to bear down."—As before.

"Bear down."—The muzzle is borne down sufficiently to enable No. 1, assisted by 6 and 7, to place the roller in the upper steps of the gudgeon plates.

"Come up."—The gun is allowed to rest on the roller.

"Prepare to lift."—As before.

"Lift and heave."—As before. As soon as the gun is lifted, 6 and 7 withdraw their handspikes and lay them down; they then fall back on to the running ends of the falls of the preventor tackles, taking a round turn round the iron bollards, the running ends coming off *on the inside*; they must ease up sufficient slack to enable the breech-tackle Nos. to haul the gun towards the trail until the trunnions lie over the flat part of the brackets, when they hold on.

"Lower."—The gun is allowed to rest with the trunnions bearing on the flat part of the brackets.

"Prepare to bear down."—As before.

"Bear down."—The muzzle is borne down and the roller removed by 1, 6 and 7. The handspike across the lever in the bore is now removed, 4 and 5 double-manning; 6 and 7 on the running ends of the falls of the preventor tackles; 10 and 11 assisting to man the lever drag-rope.

On the breech tackle *"Heave,"* 2, 3, 8, 9, 10 and 11 man the lever-rope and regulate the inclination of the gun, so that the patches may clear the transoms and stays; the breech-tackle Nos. haul the gun on to the sloping part of the brackets; 4, 5, 6 and 7 easing off. As soon as the gun is fairly on the slope, the breech-tackle Nos. cease to heave, and the gun is lowered steadily down into the travelling trunnion holes.

"Cast off tackles." *"Arrange stores."*

The tackles are overhauled and cast off, and stores arranged. The gun is secured by straps to the carriage for travelling.

Section VII.

Shifts, 64-pr.

TO SHIFT FROM TRAVELLING TO FIRING TRUNNION HOLES.

<i>Officer.</i>	<i>No. 1.</i>
<i>Shift from travelling to firing trunnion holes.</i>	<i>Prepare to shift the gun.</i> <i>Hook tackles.</i> <i>Arrange muzzle lever.</i> <i>On the tackles taut—Heave.</i> <i>Cast off tackles.</i> <i>Arrange stores.</i>

"Prepare to shift the gun."—No. 1 places the cascable bar; 2, 3, 4 and 5 cast loose side-arms and straps; 4 and 5 scotch the wheels, 4 in front, 5 in rear; 8 and 9 lash the trail-eye as before.

"Hook tackles."—4, 5, 6 and 7 hook tackles as before.

"Arrange muzzle lever."—2 and 3 place a lever in the bore; 8 and 9 making fast the lever drag-rope as before, the rope being manned by 2, 3, 8, 9, 10 and 11.

"On the tackles taut," "Heave."

The whole of the remaining Nos. man the falls on their own sides, and haul the gun up the sloping brackets. As the gun approaches the top of the slope, 6 and 7 fall off the tackles and stand by to receive the trunnions on handspike points in each of the firing trunnion holes.

"Cast off tackles." "Arrange stores."—6 and 7 work out their handspikes, tackles are removed, stores arranged, the gun is unlimbered and elevating arc put on.

NOTES ON THE MODE OF FIXING A TOP CARRIAGE ON A 40-PR. TRAVELLING SIEGE CARRIAGE FOR OVERBANK FIRE.

Top carriages and fittings are not interchangeable, i.e., they will only fit that particular travelling siege carriage for which they have been prepared.

They are marked with the No. of the carriage for which intended.

The following tools are required for securing the "top" to the lower carriage, namely:—

Knock-up wrench, large	1
McMahon spanner	1
Spanner for check nuts	1
Small half-round file for removing burrs ..	1

Before placing the top on the lower carriage the latter is stripped, i.e., the following articles are removed from it, namely:—

Side-arms and straps.

Capsquares (a different pattern of capsquare is required for the top carriage).

Coins (three: large, medium, and small).

Shifts, 40-pr. and 64-pr.

Section VII.

Worm-wheel shaft and handle: the same are suitable for *both top and lower carriage.*

Stool-bed.

Side-arm straps.

Elevating gear.

Drag-shoe hook (temporarily removed).

Temporary bolts removed from front of brackets.

Loop lashing screws removed.

Staple plate for roller removed.

The fittings for the top carriage elevating gear are now carefully adjusted between the front part of the brackets of the low carriage, care being taken that the holes in the fittings correspond with those in the carriage, or difficulty will be experienced in inserting the screw bolts.

The fittings are then nutted-up to the carriage and the drag-shoe hook is replaced, and the worm-screw shaft fixed in its bearings, front and rear. The carriage-step is put on and secured by a $\frac{1}{2}$ -inch split key.

The top carriage *may*, in case of necessity, be mounted up the trail by "man handling" it; but it is awkward work, and to be avoided, if possible, by using a gyn to raise the top carriage, which may be slung by means of a heavy drag-rope put on close in rear of the trunnion holes. When high enough the lower carriage is run under it, the four vertical tension bolts are allowed to hang down and guided into position as the top carriage is lowered, the plate with staples and straps for side arms is put on the left front tension bolt just before the top carriage is lowered.

The four vertical tension bolts are secured to the lower carriage by two plates through which their lower ends pass; a washer having first been put on each,* the bolts are nutted-up.

The "cross-stay" nuts are now tightened up, *as much as possible on both sides*, by using the powerful "knock-up" wrench.

The after part of the top carriage is secured to the trail by screw-nuts and clip plates, which latter are marked.

To adjust the elevating arc the gun should be depressed about 5° , when the ends of the arc (which are marked "muzzle" and "breech") are placed in the patches, the arc being worked into position by means of the worm-wheel. The arcs are kept in position by large pins, which are secured with washer and pin.

The travelling siege carriage of the 25-pr. R.M.L. gun is prepared for overbank fire in the same way as the 40-pr.

TO PREPARE A 64-PR. R.M.L. TRAVELLING SIEGE CARRIAGE FOR OVERBANK FIRE.

Same as 40-pr., with the following exceptions:—

Different worm-wheels and shafts are used with the ordinary travelling siege carriage and the top or overbank carriage.

* Washers are not always supplied.

Section VII.

Shifts, 8-inch Howitzer.

The stool-bed is not removed during the operation.
In order to fix elevating arc, it is *not* necessary to depress the gun.

TRANSPORTING ARRANGEMENT FOR HOWITZERS AND BEDS.

The following description of the transporting arrangement for 8-inch howitzer and bed, and the method of placing on platform, without gyn, may be taken as applicable to the 6.3-inch howitzer and bed, but as this method necessitates the employment of a considerable amount of skidding, for which no provision is made in the Siege Equipment, is slow, and requires much caution, it would be advisable, whenever practicable, to employ a gyn, in the manner hereafter described, to take the weight (for the removal of the wheels) and lower howitzer and bed on to the platform; and the converse in mounting.

TRANSPORTING ARRANGEMENT FOR 8-INCH HOWITZER AND BED.

The arrangement consists of a pair of 1st class wheels, an axle-tree with 1st class arms, and a siege limber.

The bed of the axle is rectangular (lightened in the centre), and when used for transporting is passed through a square socket in each bracket.

The rear end of the guide bar is fitted with an eye for limber hook of the siege limber.

TO DISMOUNT THE BED FROM THE TRAVELLING TO THE FIRING POSITION.

1. Lash the guide bar to the rear transom (it is already lashed to the front transom for transporting).

2. Remove the limber (Fig. 1) and raise the trail to the position shown in Fig. 2, place blocks of wood (*a*) or other skidding that may be found suitable in the equipment, slightly in rear of the centre of gravity of the whole mass, and other blocks under the breast of the bed, bear down the trail so as to raise the wheels from the ground.

3. Remove the wheels and bear up the rear end of guide bar, remove one of the blocks (*a*) and lower until the bed rests upon the remaining blocks.

4. Bear down the rear and remove one of the blocks under the breast, and continue to alternately remove one of the blocks (*a*) under the centre of gravity and those under the breast until the bed rests upon the ground platform. Before removing the last block (*a*) under the centre of gravity, remove the lashing round the guide bar and rear transom.

6·3-inch or 8-inch Howitzers.

Section VII.

5. Remove the lashing round front transom and pivot flap, and lower the pivot flap over the pivot in the front of the ground platform, and secure it with the key and lanyard.
6. Remove the transporting axle.

TO RAISE THE BED TO TRAVELLING POSITION.

The above operations must be carried out in reverse order.

Fig. 1.

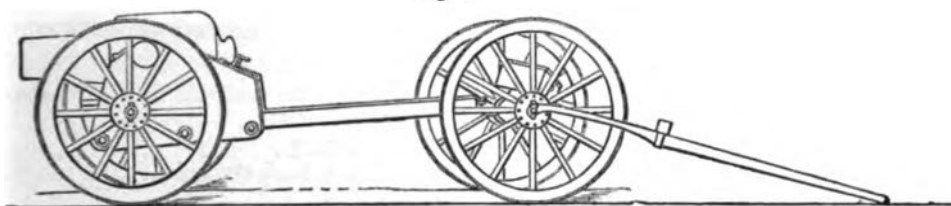
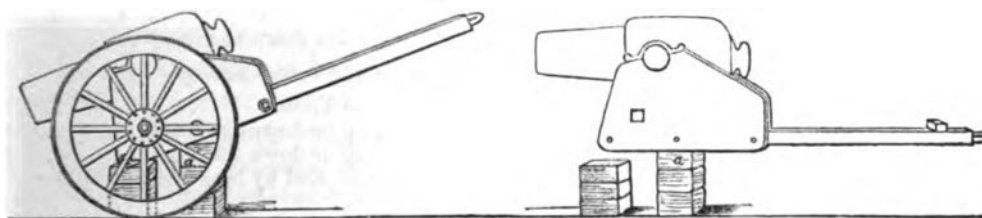


Fig. 2.



TO MOUNT A 6·3-INCH OR 8-INCH R.M.L. HOWITZER AND BED
(WITH TRANSPORTING WHEELS AND AXLE) ON PLATFORM
WITH A GYN.

The howitzer and bed on transporting wheels and axle, limbered up, having been run over its platform, with the gun-metal flap in front of the breast, vertically over the pivot bolt in front of the platform, an 18-ft. gyn is placed over the howitzer, so that the tackle hangs about 6 inches in rear of the trunnions.

To sling the bed, a 6-inch gun sling will be found convenient passed under the front and rear eye-bolts on either side of the brackets, the two bights being so adjusted, that the hook of the lower block of the gyn tackle can be passed through both. The weight being taken, the limber run to the rear, and the wheels removed, the howitzer and bed are lowered into position on the platform and the transporting axle unshipped.

Replacing the axle and wheels, and removing the howitzer and bed, is the converse of the foregoing.

N.B.—Should no gun sling be procurable, two heavy drag-ropes may be used instead. The guide bar is kept in position during the operation by putting the compressor lever hard down, and by lashing up with a drag-rope to the hook of the lower block of the gyn tackle.

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Section VIII.

Mounting and Dismounting Ordnance.

Section VIII.—Mounting and Dismounting Ordnance.

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ORDNANCE OF HEAVY SIEGE TRAIN UNIT.

40-pr. R.M.L. Gun of 35 cwt., mounted on Travelling Siege or Overbank Carriage.

64-pr. R.M.L. Gun of 64 cwt., mounted on Travelling Siege or Overbank Carriage.

8-inch R.M.L. Howitzer 46 cwt., mounted on Travelling Siege Carriage.

8-inch R.M.L. Howitzer 46 cwt., mounted on Iron Bed.*

ORDNANCE OF LIGHT SIEGE TRAIN UNIT.

25-pr. R.M.L. Gun of 18 cwt., mounted on Travelling Siege or Overbank Carriage.

* Described in § 8130, Changes in War Stores, dated 1st July, 1877.

Mounting and Dismounting 25-pr.

Section VIII.

40-pr. R.M.L. Gun of 35 cwt., mounted on Travelling Siege or Overbank Carriage.

6·3-inch R.M.L. Howitzer, 18 cwt., mounted on Travelling Siege Carriage.

6·3-inch R.M.L. Howitzer, 18 cwt., mounted on Iron Bed.

These may all be mounted or dismounted with an 18-ft. light gyn, but as the supply of gyns may be limited, and it might not be always advisable to employ one (when from their showing over the works they might draw an enemy's fire), other means of mounting and dismounting have been described.

The mounting and dismounting by means of a gyn (which must always be resorted to in the case of an Overbank Carriage, except with 25-pr.) calls for no special remarks.

TO MOUNT OR DISMOUNT A 25-PR. R.M.L. GUN ON OR FROM A TRAVELLING SIEGE CARRIAGE, BY UP-ENDING THE TRAIL.

Strength of Detachment 18 Nos. (two gun detachments).

This gun is dismounted in the same way as the 16-pr. R.M.L., except that, on account of its length, a hole is made in the ground about 18 inches deep to receive the muzzle.

"Prepare to dismount the Gun."—No. 1 removes the sights. 2, 3, 4 and 5 remove cap-squares, side arms, elevating gear, and drag shoe. 4 and 5 attach a drag-rope to the cascable by an overhand knot in the centre, passing the ends to the front. 2 and 3 man the wheels. 4, 5 and 6 stand to lift the trail. 1, 7, 8 and 9 place themselves in front of the gun and man the ropes, 1 and 8 on the right, 7 and 9 on the left.

"Dismount the Gun."—The trail is raised and the wheels manned forward till the gun is perpendicular; when the muzzle touches the ground the drag rope Nos. steady the gun on its muzzle, having hauled it out of the trunnion holes by the drag rope if necessary, and the carriage is run a few inches to the rear.

It is to be borne in mind that disengaging the gun from the carriage greatly increases the weight on the trail, and the men should be prepared for this.

"Lower the Trail."—The trail is lowered and the carriage run back.

"Lower the Gun."—The drag-rope is manned by all the Nos. on their own sides, outside the ropes, and the gun lowered by the Nos. walking forward with the drag-rope.

N.B.—A few additional Nos. may be with advantage employed at the trail. This method requires much caution. It is therefore preferable, whenever practicable, to have recourse to the plan of Mounting and Dismounting by means of long oak skids up or down the rear, which is easy, safe and expeditious.

In mounting, 2 and 3 place a handspike in the bore and lift, whilst 4 and 5 place a handspike under the gun behind the

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Section VIII.

Mounting and Dismounting 40-pr.

trunnions, to be manned by 2, 3, 4 and 5; 6 and 7 then place the rear shaft of the limber under the breech, to be manned by 6, 7, 8 and 9; the whole of the Nos. facing the muzzle. Additional Nos. man a drag-rope placed on the cascable by 4 and 5 as in dismounting, a turn being taken round the shaft with either end of the rope, the running ends coming off below; the detachment lift until the Nos. can be more advantageously employed in hauling on the rope.

The remainder of the operation is the converse of dismounting.

TO MOUNT OR DISMOUNT A 25-PR. R.M.L. GUN OF 18 CWT., ON OR FROM A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS, UP OR DOWN THE REAR.

These operations are almost identical with those described in the following pages for the 40-pr. R.M.L. gun, only there is no necessity to raise the gun out of the trunnion holes, and receive the trunnions on handspike points before placing the long oak skids in position for dismounting.

TO MOUNT OR DISMOUNT A 40-PR. R.M.L. GUN OF 35 CWT., ON OR FROM A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS, UP OR DOWN THE REAR.

Strength of Detachment, about 19 Nos. (two gun detachments will suffice).

STORES REQUIRED.

Drag-ropes, heavy	..	..	..	..	2
Handspikes, common, 6-ft.	..	..	..	..	5
Lashings, white or tarred, 1½-inch, 3 fms. each	..	..	..	..	4
Luff tackles, complete	..	..	..	..	2
Roller, ground, elm, 3' x 6"	..	..	..	..	1
Scotches, of sorts	..	..	..	..	12
Selvagees	..	..	..	..	2
Skids,* oak, 14' x 5½" x 5½"	..	..	..	..	2
Skids,† oak, 3' x 9" x 6"	..	..	..	..	1
Water bucket, filled, and brush	..	..	..	..	1

TO MOUNT THE GUN.

The ground roller should be placed under the gun, a little in front of the centre of gravity, the carriage at such a distance in front, that when the long skids are in position, their lower ends may be under the muzzle. The capsquares are removed by 2 and 3, and the wheels scotched by 4 and 5, for which purpose large scotches are to be preferred, though handspikes can be used for the purpose.

* Weight 160 lbs., or, if strengthened with iron plates at the sides, 203 lbs.

† Two 3-inch planks, one on top of the other, may be used to support the lower ends of the long skids instead of a 6" x 9".

Mounting and Dismounting 40-pr.

Section VIII.

Place skids, hook tackles.

Taut. Heave.

Remove skids, unhook tackles.

"Place skids," "hook tackles."—8, 9, 10 and 11 place the skids, the lower ends bevel down resting on a 6" x 9" on its flat; the upper bevel up on the medium and small quoins, which are placed on the stool-bed, between the front part of the carriage brackets; the thick ends of the quoins outwards, the points overlapping inwards.

The skids are cradled at their upper ends by the quoins, at their lower ends by two large scotches on the 6" x 9", and at an intermediate point by two medium scotches on the trail transom; they are hooked together with the hooks back up and lashed back to the trail handles.

The tackles are then hooked; 12 and 13 hooking the double blocks to a strap round the cascable, 10 and 11 the single to a strap round the breast of the carriage. The skids are then watered.

"Taut." "Heave."—The Nos. man the tackles on their own sides, and haul the gun up the skids until the trunnions rest on the points of handspikes placed in the firing trunnion holes by 6 and 7.

"Remove skids," "unhook tackles."—The muzzle is borne down and the skids and tackles cleared away by the Nos. who placed them; 6 and 7 working out their handspikes, 2 and 3 replacing the cap-squares; care should be taken to avoid fouling the worm-wheel shaft of the elevating gear with the moveable block of the right luff tackle; the shaft may be removed without much difficulty by taking off the whole of the upper and the outer half of the lower gun-metal bearings of the shaft by means of a spanner.

TO DISMOUNT THE GUN.

To effect this the gun must first be raised out of the trunnion holes.

Raise the gun out of the trunnion holes.

Prepare to bear down.

Bear down.

Come up.

Prepare to lift.

Lift.

Lower.

"Raise the gun out of the trunnion holes."—2 and 3 take off cap-squares and elevating arc, 4 and 5 scotch the wheels with large scotches or handspikes, 4 in front, 5 in rear.

"Prepare to bear down."—2 places a handspike in the bore, double-manned by 3, 8 and 9, 4 passes a handspike to 5 over that in the bore just in front of the face of the piece, double manned by 10 and 11, all facing the rear.

Section VIII. Mounting and Dismounting 40-pr. and 64-pr.

"*Bear down.*"—The muzzle is borne down and the gun roller placed by 7 under the breech, about 18 inches in rear of the centre of gravity and scotched up.

"*Come up.*"—The breech is allowed to rest on the roller.

"*Prepare to lift.*"—4 shifts his handspike to 5 under that in the bore.

"*Lift.*"—The gun is lifted high enough for 6 and 7 to insert a handspike in each trunnion hole.

"*Lower.*"—The gun is lowered till the trunnions rest on the handspikes.

Prepare to bear down.

Bear down.

Place skids.

Come up.

Make fast breech drag-rope.

Prepare to lift.

Taut. Lift and heave.

Remove skids.

"*Prepare to bear down.*"—As before.

"*Bear down.*"—As before, the gun roller is removed by 7.

"*Place skids.*"—10, 11, 18 and 19 (or any of the higher Nos.) hook the skids together, hook back up, and place supports and cradle them, as in mounting; they then lash them to prevent their moving towards the trail, passing the lashing ropes out to the front round the carriage brackets, and back to any convenient part of the wheels or axletree, or make fast to the felloes of the wheels in front and frap.

"*Come up.*"—The breech is lowered on to the long skids.

"*Make fast breech drag-rope.*"—11 makes fast a drag-rope (not with the hook end) to the cascable.

"*Prepare to lift.*"—The same Nos. as before prepare to lift the muzzle, the other Nos. man the breech drag-rope.

"*Taut.*" "*Lift and heave.*"—The Nos. at the muzzle lift, those on the drag-rope heave, and the gun is hauled down the long skids, which should have been previously watered, on to the ground roller placed to receive the breech.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON OR FROM
A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS UP OR
DOWN THE REAR.

These operations are nearly identical with those already described for the 40-pr. R.M.L. gun, p. 108; but it will be found, in mounting the gun, that it is heavy work, unless a few extra hands are employed for manning the tackles.

The fir skids, 14' x 8" x 8", are to be preferred to those of oak (strengthened with iron plates), 14' x 5½" x 5½" for the 64-pr gun, as affording greater strength and stability; should

Mounting and Dismounting 64-pr.—6·3-inch Howitzer. Section VIII.

oak skids however be employed, it will be advisable to support them with skidding near the trail eye in addition to the other points of support.

The skids are lashed and cradled as for the 40-pr., only the large and medium quoins are used to support their upper ends.

In raising the gun out of the trunnion holes the first lift is taken with the gun roller resting on the stool-bed; the second, with the roller resting on the large quoin placed on the stool-bed.

Care should be taken not to injure the worm-wheel shaft of the elevating gear during these operations; it can be removed without much difficulty.

In dismounting the gun it can be hauled with greater ease on to the long skids if it be allowed to move on the roller towards the trail at the second lift in raising out of the trunnion holes, and the trunnions lowered to rest on the carriage brackets between the firing and travelling holes and (temporarily) scotched up in rear.

TO MOUNT OR DISMOUNT A 6·3-INCH R.M.L. HOWITZER OF 18 CWT. BY UP-ENDING THE TRAIL.

To dismount—Strength of Detachment 19 Nos., or say two detachments.

Stores required.—The stores with the howitzer.

"Dismount the howitzer."—No. 1 removes the sights; 2 and 3 the cap squares and elevating arc; 4 and 5 scotch the wheels with handspikes; 4 in front, 5 in rear; 8 and 9 make fast a drag-rope each to the trail eye (not with the hook end); 8 leads his to the front, 9 his to the rear.

"Lift."—2, 3, 4, 5, 6, 7, 10 and 11 lift at the trail, the remaining Nos. heave on the drag-rope to the front. The trail is lifted until the muzzle rests on the stool-bed of the carriage placed to receive it by 6 and 7, the wheels are then manned back to clear the trunnions and the trail is lowered on to the ground.

TO MOUNT THE HOWITZER.

Mounting the howitzer is the converse of the above.

To bring the howitzer on its muzzle the near shaft of the limber is used, placed across under the cascable; 2 and 3 make a thumb-knot in the centre of a drag-rope and place it on the cascable, bringing the ends over and under the shaft and leading them crossed to the front; 2, 3, 4, 5, 10 and 11 lift at the shaft and steady the howitzer when on its muzzle. The trail of the carriage is lifted as in dismounting, and the howitzer pushed in the trunnion holes.

The drag-rope to the rear is used as a preventor rope by 9, and additional Nos. if required.

Section VIII. Mounting and Dismounting 6·3-inch and 8-inch Howitzer.

TO MOUNT OR DISMOUNT A 6·3-INCH R.M.L. HOWITZER OF 18 CWT. ON OR FROM A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS UP OR DOWN THE FRONT.

These operations are the same as detailed for the 8-inch R.M.L. howitzer of 46 cwt.

TO MOUNT OR DISMOUNT A 6·3-INCH R.M.L. HOWITZER OF 18 CWT. ON OR FROM A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS UP OR DOWN THE REAR.

This is probably the safest and best method that can be followed; it is precisely the same as that detailed for the 40-pr. R.M.L. gun of 35-cwt., p. 108.

TO MOUNT OR DISMOUNT AN 8-INCH R.M.L. HOWITZER ON OR FROM A TRAVELLING SIEGE CARRIAGE BY LONG SKIDS UP OR DOWN THE FRONT.

Strength of Detachment.—About 19 Nos., or say two detachments.

STORES REQUIRED.

Handspikes, common, 6-ft.	..	..	..	8
Skids, oak, 14' x 5½" x 5½"	..	..	..	2
Luff tackles, complete	..	..	..	2
Selvagees or lashing	..	..	..	3
Scotches, of sorts	..	..	..	12
Drag-ropes, heavy	..	..	..	2

It is found most convenient to mount or dismount the howitzer by the front, as it would require a great deal of skidding to support the ends of the long skids between the brackets of the carriage were it done by the rear.

TO DISMOUNT THE HOWITZER.

Raise the howitzer out of the trunnion holes.

Place skids, hook tackles.

Taut. Heave.

"Prepare to bear down."—No. 1 removes the sights; 2 and 3 the cap-squares and elevating arc; 4 and 5 scotch the wheels, 4 in front, 5 in rear, by scotches or quoins; 2 places a handspike in the bore, and 3 one under it as a wedge double manned by 8 and 9; 4 passes his handspike across to 5 and over 2 and 3's close to the muzzle, double manned by 10 and 11.

"Bear down."—The muzzle is borne down; 6 and 7 each place a small scotch between the breech coil and the brackets of the carriage close behind the trunnion holes.

Mounting and Dismounting 6·3-inch and 8-inch Howitzer. Section VIII.

"Prepare to lift."—The howitzer is lifted until the trunnions are clear, and rest on small scotches placed on handspikes in the trunnion holes.

"Place skids."—8, 9, 10 and 11 hook the skids together, backs of the hooks up, and place them with their ends bevel up on the breast transom of the carriage, the other ends resting on the ground; they are secured by a drag-rope made fast to the grummets, or the upper hooks of the skids, and to the trail eye; 9 makes fast a drag-rope to the cascable, and taking a half hitch round the chase stretches it to the front.

"Taut." "Heave."—4 and 5 apply a handspike each over the brackets of the carriage and under the breech, double manned by 10 and 11, and bear down; the Nos. on the drag-rope heave until the howitzer descends the skids and rests with its muzzle on the ground; 2, 3, 4 and 5 then apply handspikes under the muzzle and row it to the front until clear of the skids, if necessary.

TO MOUNT THE HOWITZER.

Mounting the howitzer is the converse of the above. The howitzer is placed breech towards the breast of the carriage resting on a handspike close behind the centre of gravity. The long skids are placed, as before, their upper ends lashed to the axletree arms to prevent them moving with the howitzer; their lower ends placed under the breech. The single blocks are hooked to two selvagees placed round the highest point of tires of the wheels of the carriage. A handspike is passed across under the trail and through the spokes by 6 and 7 to prevent the wheels skidding round when the strain of the tackle comes on them. The double blocks are hooked to a strap placed over the howitzer, the ends coming back under the trunnions; the howitzer is hauled up the skids until nearly up to the trunnion holes, when it is scotched up and the strap shifted to across the muzzle to prevent its being cut by the trunnion holes. It is received on the points of handspikes in the trunnion holes, and the skids removed; 4 and 5 apply a handspike each under the breech to prevent it tipping when it clears the ends of the skids.

TO MOUNT A 6·3-INCH R.M.L. HOWITZER OF 18 CWT. ON A TRAVELLING SIEGE CARRIAGE FROM ITS BED BY LONG SKIDS, OR THE CONVERSE.

As detailed for 8-inch R.M.L. howitzer of 46 cwt.

TO MOUNT AN 8-INCH OR 6·3-INCH R.M.L. HOWITZER ON ITS BED FROM OFF A TRAVELLING SIEGE CARRIAGE, OR THE CONVERSE.

Strength of the Detachment.—19 Nos., or say two detachments.

Stores required.—The same as in mounting or dismounting 8-in. howitzer on or from travelling siege carriages up or down the front by means of long oak skids, and in addition two 6-in. pieces.

Section VIII. Mounting and Dismounting 6.3-inch and 8-inch Howitzers.

The bed is run back to the rear stop on the guide bar, and held there by putting the compressor lever hard down.

The travelling siege carriage is placed in rear with its breast towards the rear part of the bed, and at such a distance that the 14-ft. oak skids conveniently span the interval between the front transoms of the travelling carriage and the bed; the wheels of the carriage are then scotched.

TO MOUNT A HOWITZER ON A TRAVELLING SIEGE CARRIAGE FROM ITS BED.

The tangent scale, elevating arc, and cap-squares are removed. The muzzle is borne down, and scotches are jammed in between the breech coil and the brackets a short distance in rear of the centre of gravity. The muzzle being lifted, handspike points are placed in the trunnion holes under each trunnion. The muzzle is again borne down and large or medium scotches inserted as before.

At the next lift at the muzzle the trunnions are received on a skid in each trunnion hole. The long oak skids, hooked together, hooks back up, are now placed, the bevels being down over the front transom of the bed, and securely lashed to prevent their moving to the rear with the howitzer. A convenient method of lashing them is to hook two drag-ropes to the connecting hooks of the skid at the upper ends, make fast the drag-ropes to the rear eye-bolts of the bed and frap.

The skids may be further lashed in front round the breast of the bed; they are then watered.

At "*Hook tackles*," the double block of a luff tackle is made fast with a selvagee to the cascable, and the single block in like manner to one of the cross stays of the trail (not to any part of the elevating gear); the howitzer is then hauled up the skids until the trunnions rest on the flat part of the brackets in front of the trunnion holes. The muzzle is now borne down and the long skids removed, after which the howitzer is hauled on to handspike points placed in the trunnion holes for the purpose. The handspikes are now worked out. In mounting, the single block of the luff tackle must, when necessary, be shifted back and secured with a selvagee to the trail eye. If the carriage is inclined to tip during the operation, a 6-in. piece on its end should be placed under the front of each bracket. When the howitzer is fairly on the long skids, those skids which were in the trunnion holes may be used for this purpose.

TO MOUNT A HOWITZER ON ITS BED FROM A TRAVELLING SIEGE CARRIAGE.

This operation is the converse of the foregoing, except that the skids must be so placed that their points only just overlap the

Mounting and Dismounting 6.3-inch and 8-inch Howitzers. Section VIII.

front transom of the bed, or difficulty will be experienced in clearing them, and they are lashed in the opposite direction.

To haul the howitzer on to the bed, two luff tackles are employed; their double blocks being made fast with a selvagee to the cascable of the howitzer and their single blocks hooked into the front eye-bolts of the bed.

A drag-rope, made fast to the chase, should be employed as a preventor to guard against the howitzer sliding too violently down the skids.

Section IX.—Methods of Laying.

A.—When the object fired at is visible over the sights—

1. *The tangent scale is used.*

No. 1 removes the tangent scale from the gun, and sets it by bringing the top of the moveable socket to the required division on the yard or degree scale and clamping it. (Any odd number of minutes is given on the slow motion screw at the head of the scale). If any deflection is wanted, he sets the arrow on the sliding leaf to the required division and clamps it. (In the howitzers the tangent scales are vertical, and deflection must therefore always be given. Any deflection required from accidental causes, such as wind, &c., must, if left, be added to, if right, be deducted from, the deflection shown in the range tables).

No. 1 having set his scale replaces it in the gun, taking care that the socket is home.

He then lays with a full sight, i.e., he brings the top of the notch, the apex of the foresight and the point aimed at in line.

To ensure good laying the following rules must be observed :—

The eye not to be less than one foot in rear of the tangent scale notch, if possible more, and the distance between eye and notch not to be varied from round to round.

The head to be upright and the body in an easy position, supported if possible by holding on to or resting on the cascable.

The most conspicuous point in the object to be chosen to lay at.

The operation of laying to be completed as rapidly as possible so as not to fatigue the eye.

The gun to be laid a little above the object and then depressed on to it. This ensures the teeth of the elevating arc being in bearing with the driving pinion.

If the elevating gear is unserviceable and the gun has to be elevated by handspikes, the elevation should first be roughly obtained, 2 and 3 applying their handspikes under the breech and 4 attending to the quoin, the gun being laid a little above the mark.

It is then traversed into line and the final adjustment for elevation obtained by 2 tapping the small quoin with his handspike.

B.—When the object is visible from the battery, but the line of sight obscured by the parapet.

2. *Laying by plumb line.*

If No. 1 can see the object from some spot immediately in rear of the gun (by standing on an empty shell box, &c.), he can obtain the direction by plumb line.

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He first sets the tangent scale to the required deflection. Then standing in rear of the gun he holds the plumb line so that it cuts both the sights. If the object is on the right of his line he gives "*Trail left,*" and *vice versa*. When the plumb line cuts both the sights and the object, the direction has been obtained.

The elevation is given by quadrant or clinometer. In the howitzer a plane surface for the quadrant is cut on the breech; but as this does not exist on the guns, extra care must be taken in applying the quadrant so that it may always be placed in the same position on the top of the breech, and parallel to the axis of the gun.

Note.—The quadrant angle is the same as the angle of elevation when the object fired at is in the same horizontal plane as the gun or howitzer. If the object is below this horizontal plane, the quadrant angle is less, if it is above, the quadrant angle is greater than the angle of elevation. If, therefore, there is a great difference of level between the firing point and the object, the angle which a straight line joining the object and firing point makes with the horizon (the angle of sight) must be ascertained, and added to or deducted from the angle of elevation (as given in the range tables), in order to obtain the quadrant angle, *i.e.*, the number of degrees and minutes at which the quadrant should be set.

3. *Laying by hanging scales.*

A set of scales, consisting of a front and rear scale, with light iron rods for suspending them from the carriage, forms part of the equipment of travelling wrought iron siege carriages.

The front scale hangs from the lower part of the axletree, and the rear one between the trail brackets. The scales are graduated on both sides so that they can be read from either front or rear, and as they are constructed with a view to being read from a distance, the centres of the divisions are used and not the lines marking them. Thus commencing at the left, the first division is 0, the second 5', the third 10', the fourth 15', and so on. The white divisions are all tens, the number of the ten being shown by the figure above—thus, 3 tens = 30 minutes.

The rear scale is longer than the front one, as it has a deflection scale of 4° at its right extremity.

The scales are so constructed that if corresponding divisions of both of them are over the line of direction (no allowance being made for deflection) the axis of the gun will be in a vertical plane parallel to it.

The method of using the scales is as follows:—

The line of direction having been obtained, as in § 2 (or otherwise), it is marked by a line drawn (with pencil, chalk, &c.) on the platform or on a plank or batten laid for the purpose.

The scales are adjusted so as to hang perfectly horizontally and clear of all impediments, but not too high to prevent the divisions being clearly seen in connection with the line of direction.

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If the line has been obtained over the sights, as in § 2, No. 1 ascertains what division of the front scale is cut by the line, and slides the rear scale to the left until it reads the same as the front one. If the direction of the first round is good, all that is necessary in succeeding rounds is to traverse until the rear scale reads the same as the front one.

If any correction for deflection is found necessary the rear scale must be adjusted accordingly.

The scales must be removed before firing. 2 attends to the front and 4 to the rear scale.

Should the line of direction not have been obtained over the sights of the gun, then, for the first round, the deflection shown in the range tables must be given on the rear scale and the gun traversed until the two scales read the same. Any requisite correction being given after the first round as before.

The elevation is obtained by quadrant, as in § 2.

4. *Laying by an auxiliary mark in front.*

If there is a conspicuous object near the line of fire (such as a church spire) which is visible over the sights, No. 1 can, after laying the gun by the method described in § 2, put up his tangent scale and move his deflection leaf until his line of sight passes through the new object.

With the elevation and deflection thus obtained, he may lay on this auxiliary mark for the succeeding rounds.

This plan is more applicable to the howitzers than the guns, as their long deflection bars give them a larger field of view over the sights.

5. *Laying on an auxiliary mark in rear.*

This method, also called the reverse system of laying, is the converse of the last.

A conspicuous object some distance (the farther off the better) in rear of the gun is selected, and No. 1 places himself in front of the foresight and looks over this sight at the object. 4 by his directions moves the tangent scale and deflection leaf until the line is obtained.

6. *Laying by Captain French's scales.*

By this system the reverse method of laying is made applicable under all circumstances.

There are two scales, the rear one fitting into the tangent scale socket and the front one into the foresight socket of the gun.

The rear scale consists of a steel bar graduated like the tangent scale, and fitted with a moveable socket and clamp. The head of the scale is rectangular and has a slot cut in it, in which a horizontal gun metal bar is free to slide.

The top of the horizontal bar is graduated from 0 to 8 into degrees and divisions of 5 minutes.

On the left of the bar is a deflection scale by which a deflection of 1° right and 3° left can be given.

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If no deflection is required, the left zero mark is made to coincide with the left face of the head.

A sliding leaf with a triangular apex is free to move along the bar. Both horizontal bar and sliding leaf are provided with clamping screws.

The front scale has a fixed horizontal bar similar to that of the rear scale, and graduated from 0 to 8. It has also a sliding leaf with a sighting notch on the top and a clamping screw in front.

The following is the method of using the scales:—

The gun having been laid as described in § 2, No. 1 sets the rear scale to a convenient height (so that his line of sight will be approximately horizontal). He adjusts the horizontal bar without deflection, and slides the leaf to one of the divisions near the centre of the bar. He then tightens all the clamping screws and goes to the front of the front scale. He clamps the sliding leaf of this scale to the same division at which the rear one is set, and looks over his sights.

Under his direction a plumb line is suspended about 4 yards in rear of the gun, and another line suspended or a mark made about 10 yards in rear of the first (or farther back if possible). The plumb line and rear mark are so placed that they are accurately in the prolongation of the line of sight, and they are adjusted at such a height that No. 1 can see them both when looking over his sights. By raising or lowering his rear scale, No. 1 can adjust his line of sight for the most convenient position of the plumb line and rear mark.

He has thus four points in line, and, by noting the height of his rear scale when he has laid on the mark, he has a means of obtaining the elevation in succeeding rounds independent of the quadrant. He removes the scales from the gun before it is fired.

After the first round he lays as follows:—

a. He gives any necessary correction in elevation and deflection on the rear scale (by the same rules as with the service sights), clamps it and inserts it in the tangent scale socket. He then unclamps the leaf and slides it to the end of the horizontal bar.

b. He goes to the front of the foresight, unclamps the leaf and slides it along the horizontal bar until the notch is in the same line as the plumb line and mark. He then clamps it.

c. Under his direction, 4 sets the sliding leaf of the rear scale so that it reads the same as the front one.

d. He lays the gun (2 and 3 traversing and 4 elevating) by giving trail right or left and elevate or depress until the line of sight cuts both plumb line and mark.

7. *Laying on plumb line, &c., to the rear with service sights.*

This method of laying (by plumb line and mark in rear) is applicable to the service sights. It would, however, entail a loss of time from the gun having to be cross-lifted into the original line nearly every round, but it is a useful method for howitzers mounted on beds.

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C.—When the object fired at is not visible from the battery.

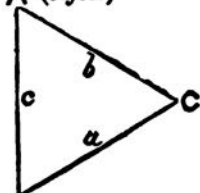
8. *Obtaining the line of fire.*

If the object is visible from any elevated spot of ground in rear of the battery the line may be obtained by plumb line as in § 2.

If it is visible from some point in front of the battery, two men (*A* and *B*, provided with pointing rods) can obtain the line as follows:—*A* lines *B*'s rod on the battery, *B* lines *A*'s rod on the object. They move about until the rods are correctly laid and then plant them. The line thus obtained can then be projected to the rear by running a line of rods or banderols up to the battery.

If there is no spot either in rear or in front whence the object can be seen, some spot on the flank must be found whence both the battery and the object are visible. The distance of this spot from the battery and object is measured (by range finder) and the included angle taken by pocket sextant.

A (object)



B (battery)

The sides *AC* and *CB* and the included angle *ACB* of the triangle *ABC* are then known and the remaining side *BA* (the required range) and remaining angles can be calculated.

The angle by the formula $\frac{a+b}{a-b} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$
and the side by that of $c = \frac{a \sin C}{\sin A}$.

Having found the angle *ABC*, the sextant is set at this angle, and the officer using it places himself at the point *B*, which should be in rear of the gun. He sees the point *C* by direct vision, and has a picket or pointing rod moved along the parapet until its reflection cuts *C*. The rod is then in the line of fire *BA*.

The line of fire may also be obtained roughly from a good map or plan.

9. *Laying the gun.*

Having obtained the line of fire by any of the preceding methods, the gun may be laid by any one of the methods described in §§ 3 to 7 found most convenient or applicable to the case in point.

In firing either guns or howitzers at elevations of 10° and upwards it is important to ascertain if the trunnions are level. The difference of level should not be great if the platform has been properly laid, but after continued firing (especially from a howitzer on its bed at high angles of elevation, if the howitzer is not in the centre of the platform) even the best laid platform is liable to give slightly. If the difference of level exceeds 1° the platform should be levelled at the first opportunity or pieces of plank placed under the lower wheel—one inch of plank for each degree difference of level. If the difference is within 1° it may be corrected by giving

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deflection on the scale on the higher side according to the formula—

$$\text{minutes' deflection} = \frac{n \times \theta^\circ}{60} \text{ where } \begin{array}{l} n = \text{the number of minutes' difference of level} \\ \theta = \text{angle of elevation in degrees.} \end{array}$$

The howitzers have cross planes cut on them for the quadrant. The guns have not; with them the level must be ascertained by applying the quadrant to the horizontal lines on the face of the muzzle, or on a straight rod placed across the top of the wheels—(a drag rope hooked into the washer of one of the wheels, passed over the top of the wheels, and stretched tightly, by the detachment hauling on it on the opposite side, might be substituted for the rod in case of necessity).

10. *Firing by night.*

If the enemy's works are illuminated.

If this is done by means of the electric light the firing may be carried out as in the day time.

If by star shells, which only give a momentary illumination, the guns in the battery would be loaded, and the elevation and direction roughly given before the star shells are fired. As soon as the enemy becomes visible, the laying is completed and the gun fired.

The object of lighting up an enemy's works is to ascertain if he is repairing his batteries or throwing up new ones, and to guard against sorties, &c.

Night firing under normal conditions.

The only two methods available are the hanging scales and Captain French's. The line will have been obtained and corrected by daylight.

a. *Hanging scales.*

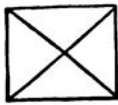
The gun is laid as described in § 3, but a lantern is required to light up the scales.

b. *Captain French's.*

A light is substituted for the rear mark. The gun is laid as described in § 6.

The simplest plan is to use for the rear mark a box or frame, inside which the lantern can be placed. The line is thus not disturbed.

The front of the box or frame should consist of a plate of ground glass, oiled linen or some other semi-transparent substance, of a light colour, with thick wires stretched diagonally across it, whose intersection is the point to lay on both by day and night.



Section IX.

Stowing of Ammunition.

STOWAGE OF AMMUNITION.

a. POWDER.

The powder will invariably be supplied to the batteries made up into cartridges, packed in metal lined cases. The charges will have been previously determined, and depend on the distance of the various batteries from the objects they are to attack and the nature of fire to be employed. For instance:—

The full charge of the guns and maximum charges of the howitzers would be used in bombarding from long ranges, in dismounting fire and in direct breaching fire.*

Reduced charges would be used from the guns and maximum charges from the howitzers in indirect breaching fire.

In high-angle fire from the howitzers (to destroy bomb proofs, magazines, &c.), the charge would be adjusted to the range, so as to give the angle of descent required.

The following is the capacity of the metal lined cases, the cartridges being packed in them without paper covers:—

8-in. M.L.R. howitzer,	11 10lbs.,	21 5lbs.,	47 2½lbs.	} R.L.G. powder.
6·3-in. M.L.R. howitzer,	27 4lbs.,	40 3lbs.,	57 2lbs.,	
64-pr. M.L.R. gun,	9 12lbs.,	11 10lbs.		
40-pr. „	16 7lbs.			
25-pr. „	27 4lbs.			

If we assume the rate of firing to be 10 rounds per gun per hour by day, and half that number by night, say 180 rounds per gun in the 24 hours, the following would be the number of metal lined cases required for 24 hours' firing from the various pieces:—

8-inch howitzer, 17, 9, or 4, according to the charge.
 6·3-inch howitzer, 7, 5, 4, 2, do.
 64-pr. gun, 20 or 17.
 40-pr. gun, 12.
 25-pr. gun, 7.

The size of the expense magazine is 4 feet high, by 4 feet 9 inches broad. The metal lined cases should be stowed in tiers, two deep, with the moveable tops inwards, leaving a passage on one side so that the magazine man can, if necessary, open any one of the cases in the front without removing it.

The magazine will thus contain 12 metal lined cases in every 3 feet of length.

The cartridge recesses in the parapet will hold about 2 cases, which should be replaced from the magazine as required, the empty cases being taken away.

b. PROJECTILES.

These will as a rule be supplied from the park, filled, and plugged and fitted with gas-checks if necessary. They will be

* It is worthy of note that the German manuals lay down 656 ft. for the 40-pr. and 525 ft. for the higher calibres, as the smallest permissible striking velocity for breaching purposes.

Preparation of Ammunition.

Section IX.

arranged on their bases (care being taken not to damage the gas-check) or sides as most convenient round the gun portions and in the trenches of communication.

The tubes and fuzes, in tin boxes, will be kept near the shells or in an adjacent recess or bomb proof.

PREPARATION OF AMMUNITION.

a. CARTRIDGES.

These, as already stated, will be made up in the park. When the small charges for the howitzers are being made up, the powder from several barrels should, whenever possible, be mixed. Greater uniformity of shooting will thus be obtained.

b. PROJECTILES.

The principal points to be attended to are to see that the studs and gas-checks of the shells are in good order. If there are any burrs on either they must be hammered and filed down until there is no difficulty in entering the shells into the bore. For shells without studs the gas-check plug should be screwed in so tightly that the gas-check cannot be turned unless the plug is loosened. If the shells fitted with gas-checks are also studded, care must be taken that the projections on the gas-check are in prolongation of the rows of studs, and the gas checks should not be screwed down too tightly. The shells should be perfectly clean and free from dirt, sand, &c., when sent up to the gun.

c. FUZES.

When firing time or sensitive percussion fuzes from the howitzers at high angles of elevation in wet weather, the muzzle of the howitzer should be covered over unless it is intended to fire immediately after loading. If this is not done the priming of the fuze might become damp or wet and blind shells would result.

At low angles the shell should be pushed well into the bore before uncapping the fuze.

PROJECTILES.

1. The common shell is the principal projectile of the siege artillery.

a. When fired from guns the R.L. percussion fuze is nearly invariably used with it.

It may be employed for breaching or demolishing masonry, destroying buildings, earthworks, &c., dismounting the guns and injuring the personnel of the enemy.

In breaching it will, when possible, be used in combination with the battering shell. The latter has greater penetrative power, and

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1 2

Section IX.

Projectiles.

by destroying the hard face of a revetment, &c., gives the common shell with its larger bursting charge a better chance of producing its maximum effect.

If an earthen parapet has to be destroyed, it should be cut down gradually, commencing at the top. It has been found by experience that a shell exploding low down in a parapet will merely throw up a mass of earth, which frequently falls back again into its original position.

Dismounting fire against guns, carriages, &c., to be effective should be enfilade. A direct frontal fire is comparatively harmless. A gun seen directly from the front offers a very small mark, and it may be hit many times (unless struck on the muzzle or trunnions) without being dismounted or even seriously injured.

b. When common shells are fired from howitzers, sensitive percussion fuzes are used.

Howitzer fire is used for bombarding purposes, for destroying the enemy's matériel, penetrating the roofs of his bomb proofs and magazines, and for breaching or demolition when indirect fire has to be employed.

Howitzer fire, especially at short ranges, is more effective than gun fire against matériel, as the low velocity of its heavy common shells spreads the destructive effect of their burst over a larger area. When used against matériel the shells may be either fired with the lower charges at high angles, so as to drop them into the gun emplacements, or with the higher ones at moderate angles, the howitzer being laid direct on the enemy's guns, so as either to strike them directly, or to burst the shells in front of or over them after grazing on the parapet.

When used against bomb proofs, &c., the charge should be regulated so as to give as high an elevation and consequent penetration as possible.*

The penetration of both 8-inch howitzer and 6.3-inch howitzer shells at high angles of elevation, and at ranges within 1,000 yards, is very small.

Time fuzes bored long or left full length may be used at high-angle howitzer fire (when the shells do not ricochet after impact), so as to obtain the maximum penetration of the shell before it bursts.

When howitzer fire is used for breaching, either the maximum charge or one closely approximating to it must be used, or the striking velocity of the shells would be insufficient for effective penetration. As low an angle of elevation as possible should be used.†

* The Germans use angles of elevation up to 70°, and find the penetration at that angle nearly double what it is at 40°; but as our carriages limit the angle to 40°, and no higher elevations are given in the range tables, we are in practice limited to that angle. The only way to increase the penetration is then to increase the range.

† Within these limits the charge and elevation must be adjusted to suit the range and the conditions of fire; i.e., the shell must clear the intervening obstacle and yet strike the wall to be breached at the lowest point intended to be hit (generally one-third of its height from the bottom).

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2. Battering or breaching shells are at present only introduced for the 64-pr. gun. They are to be used with a 12-lb. charge.

As their penetrative power is greater than that of common shells, but their explosive effect less, on account of their smaller bursting charge, they will generally be used first so as to destroy the face of the wall or revetment and give the common shells a better chance of penetration.

3. Shrapnel fire is of little value against troops behind earthworks, unless they can be enfiladed. It will generally be employed against the enemy's working parties, sorties, &c.

The time fuze should be bored so as to burst the shell from 50 to 100 yards short of the object fired at.

4. Case shot is used at ranges within 600 yards to repel sorties, &c. On good ground the gun may be laid point blank up to 200 yards range, and about $\frac{1}{2}^{\circ}$ elevation given for every additional 100 yards. On broken or boggy ground more elevation must be given.

5. Star shells are fired from the howitzers, and are intended to illuminate the enemy's works at night to ascertain if he is repairing them, &c. They are effective up to about 1,200 yards' range.

The charge elevation and time fuze must be adjusted so as to burst the shells from 100 to 200 feet up in the air, and in rear of and to windward of the spot intended to be illuminated.

The maximum effect is obtained when the stars fall in rear of and slightly to windward of the enemy's works, to which the illuminated smoke from the stars forms a background. They are useless if they fall short or to leeward of the enemy.

OBSERVATIONS OF THE EFFECTS OF FIRE.

Good results cannot be expected unless the effect of each round is carefully watched and noted. If it is impossible, from the immediate neighbourhood of the battery or from the battery itself, to observe the impact and burst of the shells, an observing station should be established in front and not too much on the flanks of the battery,* from which the result of each round or series of rounds can be communicated by signal to the Officer Commanding the battery.

If the fire is directed against guns, &c., behind earthworks, hits in the parapet can frequently be recognized, the smoke from the short bursts obscures the enemy's works, that from the bursts over forms a background on which the works will be more distinctly seen.

* If the station is too much on one of the flanks, the observer is liable to confuse shells falling right or left of the line of fire with those falling short or over. For instance, if he is on the right a shot falling to the left of the object would appear to him short, and *vice versa*.

Section IX.

Observations of the Effects of Fire.

In breaching fire the sound of the bursts is sharp when the shells explode on masonry, smothered when they explode in earth. The *débris* from the wall is often thrown up to some height in the air by the explosion. Before the wall is penetrated the smoke will be observed almost immediately on the explosion, when it has been penetrated the smoke is longer in appearing, and the sound of the bursts is duller than before.

In making corrections in elevation it must be remembered that half the number of rounds fired may be expected to be short of and half beyond the mean point of impact (or mean range).

For instance, if the object is to dismount an enemy's guns, &c., by frontal fire, the mean point of impact should be as nearly as possible the interior crest of his parapet. If therefore half the rounds are observed to strike the parapet or fall short, and the other half burst in rear of the parapet, we know that the elevation is correct. If in the course of the practice more than the proper proportion of rounds are observed to fall short or over, the elevation should be corrected accordingly.

The lateral deviation must be observed and corrected from the battery itself.

Rockets.

Section X.

Section X.—Rockets.

CONSTRUCTION.

The only rockets at present in use as war rockets are the 24-pr. and 9-pr. of Hale's pattern. It is important to remember that Mark I. is unserviceable, in case of its still existing at some out-station.

The head is of cast iron plugged with wood and riveted on to the body. The latter is of Atlas metal (a mild steel made by the Bessemer process) lined inside with brown paper and calico, the latter being inside the turns of the former. The object of this lining is to prevent the contact of the metal and the composition. The seam of the body is riveted together and brazed. The base is closed by an iron disc secured to the body by screws, and the disc is tapped to take the tail-piece. The tail-piece is of cast iron cupped out inside, and contains three conical vents, the larger part of the cone being towards the interior of the rocket. The vents are cut away on one side; and in consequence of this, the gas issuing from the vents meets with resistance on the side where the vents are prolonged, and, there being no counterbalancing resistance where the vents are cut away, rotation is given to the rocket. The tail-piece and vents are protected from injury, and the interior of the body from damp, by a covering of canvas secured by twine. Under the canvas is leather, to prevent the sharp edges of the tail-piece from cutting the canvas.

COMPOSITION.

The composition consists of saltpetre, sulphur, and charcoal, mealed and intimately mixed. It is pressed into pellets and driven into the rocket by hydraulic pressure. It is separated from the head by a mill-board disc, and is bored so as to expose a considerable amount of surface to ignition when the rocket is fired, as otherwise gas would not be formed rapidly enough to start the rocket.

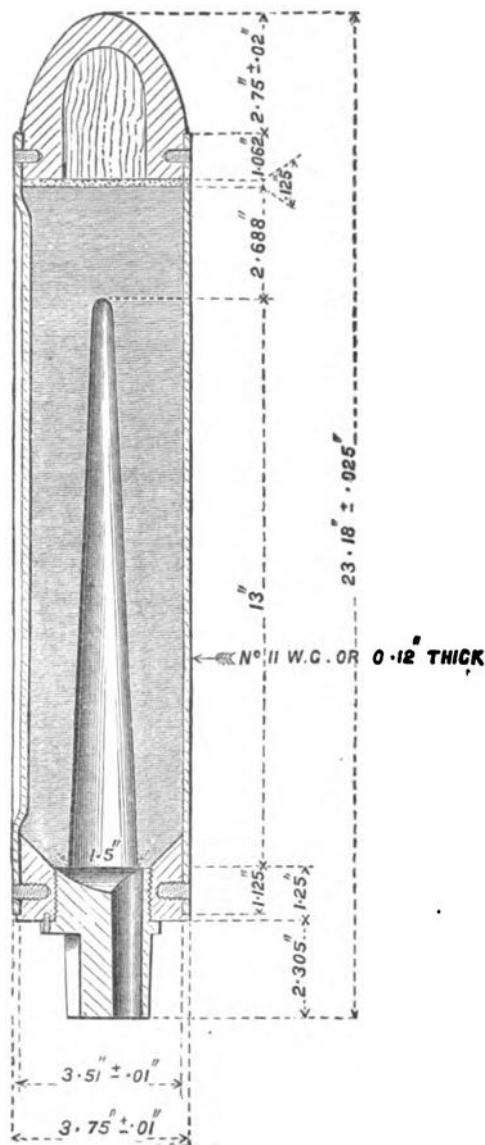
The whole of the rocket is painted red, and has its numeral and date stencilled on it in black.

The numeral is also stamped on the base of the rocket. Each rocket, moreover, has a letter and number stamped on it.

Section X.

Rockets.

24-pr. Rocket, Mark IV.



The above description applies to the latest patterns of rockets viz., 24-pr. Mark V., and 9-pr. Mark VI.

The earlier patterns have bodies painted inside and corrugated to prevent the composition from twisting away from the case, and have no paper lining. Up to Mark III. 24-pr. and Mark IV. 9-pr. the tail-pieces were not cupped out, and the cavity in the composition was smaller. The alteration has given about 300 yards' increase of range, owing to the larger surface exposed for ignition and the probable greater facilities for escape of slag. The earlier patterns have no canvas protection to the tail-pieces, the vents being merely closed with a piece of varnished paper.

Rockets.

Section X.

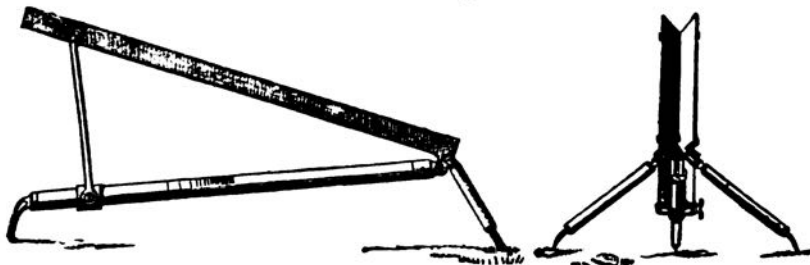
The reason generally given for the motion of the rocket is, that there is a greater pressure on the head than on the base owing to the gas escaping through the holes in the base, and therefore not acting on so large a surface.

The rocket is ignited either by placing in one of the vents a friction tube, and firing it with a lanyard, or by placing quick-match and firing it with a port-fire or slow match.

Any rockets showing rust about the case should be specially examined; if there is corrosion on the seams or joint the rocket is probably dangerous, because the inside of the case may be rusty, and the flash will penetrate the porous rust, causing the composition to burn explosively. Mark II. to be specially inspected every quarter and 3 per cent. sent to Woolwich from several large stations. The case is not painted on the inside, and is therefore liable to corrode.

Rockets are fired out of a trough, the construction of which is shown by the plate. There are two sizes, one for the 24-pr. and the other for the 9-pr. Elevation is given by means of a bar, one end of which is fastened to the front of the trough, the other to a gun-metal ring which slides on the front leg, the scale is

Rocket Trough.



marked on the leg in degrees, the ring being brought to the required elevation and clamped; 15° can be given with the 9-pr. machine, and 25° with the 24-pr. A rough rule for elevation is: each degree gives 100 yards of range. It is to be remarked that this method of giving elevation does not answer well unless the three feet of the trough are on the same horizontal plane; when not so, a clinometer or quadrant should be used when procurable. A rocket can be fired from the ground by raising and supporting the head.

Range.—Rockets are very uncertain both as to range and direction, the 24-pr. at 15° of elevation has been found to vary between 2,226 and 1,546 yards, while 9-prs. have ranged between 1,371 and 2,228 yards.

Use.—Rockets have been used for bombarding towns, firing shipping, buildings, &c. There is, however, no carcass rocket in the service. They have also been used against troops and are useful against cavalry, as they frighten the horses.

Rockets are issued in wood cases, that for 24-pr. holding 6, and that for the 9-pr. holding 12.

Section X.

Rockets.

ROCKET DRILL.

The detachment consists of 5 Nos., and is told off as for gun drill.

GENERAL DUTIES.

No. 1 points and commands.

Nos. 2 and 3 dismount the trough from the wagon and place it in position; they also replace it on the wagon.

No. 2 traverses, elevates and loads.

No. 3 assists 2 to elevate, and fires.

No. 4 supplies 2 with rockets.

No. 5 supplies 4 with rockets from the wagon.

PREPARE FOR ACTION.

Officer.

Prepare for action.

No. 1.

Prepare for action.

No. 1 provides a plummet-line.

2 and 3 dismount the trough from the wagon and place it in position, taking care that the feet rest firmly in the ground.

3 provides lanyard and friction tube pocket filled (or quick match—slow match in linstock—and portfire if required).

5 prepares to issue rockets to 4.

1, 2, and 3 take post on the trough; 1 in rear of it, 2 on the right, 3 on the left.

TO LOAD.

Officer.

Range—yards.

No. 1.

Muzzle right.

Muzzle left. Halt.

Elevate.

Depress. Halt.

Load.

The trough is laid on the object before loading. No. 1 standing in rear of it obtains the line by aid of the plummet, or by aligning the trough.

"Muzzle right or left," 2 moves the front of the trough to the right or left.

"Elevate" or "depress," 3 unclamps the elevating bar and adjusts it at the required elevation, under No. 1's directions; 2 raises or lowers the trough.

Rockets.

Section X.

"*Load*," 5 supplies a rocket to 4, who hands it to 2; 2 places it in the trough, with one of the vents opposite the slot in the trough for the friction tube.

3 hooks a tube to lanyard, or lights a portfire.

<i>Officer.</i>	<i>No. 1.</i>
<i>Fire—rounds.</i>	<i>No. — Ready.</i>
	<i>No. — Fire.</i>

"*Ready*," 3 passes a tube through the slot of the trough into one of the vents of the rocket. He then passes the lanyard under the hollow of the left foot (which should bear on the hind rest of the trough), so as to avoid upsetting it; holding the lanyard in the right hand he stands ready to fire, facing to the rear.

At "*Fire*," he gives a strong upward pull without jerking the lanyard, and keeping as much weight as possible on the left leg.

If quick match is used, a hole having been made through the canvas covering of one of the vents, a strip of it is introduced in the vent, and lit by any means available.

Rocket practice is improved by keeping the trough well wetted.

The detachment should be cautioned to stand well clear of the rear of the rocket when about to be fired.

Section XI.

Description of Material (64-pr.).

Section XI.—Description of Material.

64-PR. RIFLED MUZZLE-LOADING GUN. MARK III.

DESCRIPTION.

Length	nominal	..	..	9 feet 3½ inches.
	of bore	..	..	8 feet 1½ inches.
	of rifling	..	..	7 feet 6½ inches.
Preponderance	..	..	..	3.75 cwt.
Calibre	..	..	..	6.29 inches.
Nominal weight	..	..	..	64 cwt.
Grooves	..	..	..	3
Twist of rifling, uniform	..	..	..	1 in 40 calibres.

SIGHTING.

The 64-pr. guns have six sights: Two tangent sights, or side sights, one centre hind sight, and three fore or trunnion sights.

The tangent scale is graduated to 15°; it is also graduated in yards for 10-lb. charges, and with a fuze scale.

PROJECTILES.

				Weight.	
				lb.	oz.
Shells	Battering*	empty..	..	86	4
		filled, with 3 lb. 10 oz. bursting charge	..	90	0
	Common	empty..	..	56	14
		filled, with 7 lb. 2 oz. bursting charge	..	64	0
	Shrapnel	filled, with 234 mixed metal bullets, 14 per lb., and 9 oz. bursting charge	..	66	9
		Shot, case, filled with 50 8-oz. sand shot, clay and sand	..	49	14½

CHARGES.

Muzzle velocity, with { 12-lb. charge and 90-lb. shell, 1285 feet.
10-lb. charge and 64-lb. shell, 1383 „

Charge, 12 lb. Projectile, 90 lb.

Range in yards.	Velocity.	Energy.	Energy per inch of shell's circumference.
	feet per second.	foot tons.	foot tons.
0	1285	1024	52
500	1179	863	44
1000	1090	737	38
1500	1023	649	33
2000	974	588	30
2500	934	541	27.6
3000	899	501	25.7

* Fitted with gas-checks.

Description of Material (64-pr.).

Section XI.

64-PR. CARRIAGE AND LIMBER. MARK I.

This carriage is similar to the 40-pr. carriage, Mark II., but has not the strong stay to the rear transom as in the latter, and is fitted with two instead of one drag shoe, in order that the wheels may be skidded when necessary to check the recoil. The carriage admits of 40° elevation, or 10° depression being given to the gun. The fittings for the hanging scales and for carrying coins, side arms, &c., are similar to those for the 40-pr. carriage. An extractor is carried in addition to the other side arms beneath the trail.

OVERBANK CARRIAGE.

For siege purposes an overbank carriage constructed to fire over a 5-feet 6-inch parapet is used.

The "overbank" is the service pattern carriage fitted with a top of wrought-iron, a special elevating gear arranged to depress 20° for loading, and a step for laying the gun.

The top is formed of two bracket sides, connected by cross bolts, and secured to the carriage at the front by a strap bolt on each side of each bracket, and at the rear by clips and bolts. The elevating arrangement consists of a worm-shaft and wheel, working an elevating pinion and arc by means of a friction cone. This gear is fixed at the front of the carriage, between the brackets, and is driven by a hand-wheel, the elevating arc being secured at each end to the underside of the gun.

The following is the method of removing the top:—

Depress the gun, detach the elevating arc, turn the hand-wheel of the elevating gear until the teeth of the arc are clear of the pinion, when the arc can be removed from the rear, and the gun dismounted; take off the nuts and clip plates of the strap bolts, and remove the rear clips and bolts, which will allow of the top being lifted off.

Weight of top..	..	..	..	14½ cwt.
Height to centre of gun at trunnions	..	..	..	6 ft. 2 in.
Elevation	..	..	..	35°
Depression	..	..	..	5°

A breech loop, wood roller, and cast-iron roller (metal bouched) are supplied with these tops; they are required for shifting the gun from firing to travelling trunnion holes.

The limber is the same as for the 40-pr., but carries one special box to contain stores and carries no ammunition boxes.

The weight of the store box packed is 1 cwt. 0 qr. 12 lb.

Section XI.

Description of Material (40-pr.).

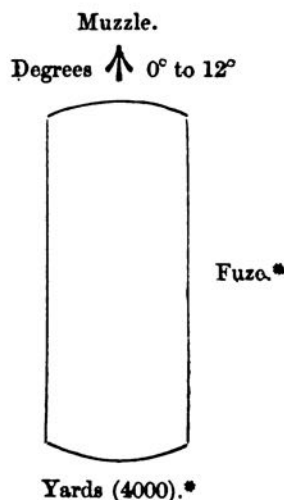
40-PR. RIFLED MUZZLE-LOADING GUN, OF 35 CWT.
MARK II.

DESCRIPTION.

Length	{ nominal	..	9 feet 6 $\frac{3}{4}$ inches.
	{ total ..	..	10 feet 0 inches.
	{ of bore	..	8 feet 8 $\frac{1}{2}$ inches.
	{ of rifling	..	7 feet 6 $\frac{1}{2}$ inches.
Preponderance (average).. 24 lb.			
Calibre 4 $\frac{3}{4}$ inches.			
Weight (average) .. 34 cwt. 2 qrs 1 lb.			
Twist of rifling (uniform).. 1 in 35 calibres.			
Vent of hardened copper.. 1 inch from end of bore.			

The gun is side sighted only, viz.:—

Two tangent sights are set at an angle of 1° 20' to the left to correct permanent deflection; the cross-head is graduated to 30 minutes right and left for deflection, in order to allow for wind or other irregularity, and is provided with a gun-metal sliding leaf; there is also a slow motion elevating nut under the cross-head graduated round its circumference from 1 to 10 minutes for finer adjustment in elevating. The tangent bar is four-sided, and is marked thus:—



There are two trunnion sights of the ordinary service drop sight patterns, and which are interchangeable with 25-pr. R.M.L. The tangent sights are not interchangeable with 40-pr. Mark I. gun.

A clinometer is supplied for elevations above 12°.

* These graduations are correct for shells fitted with gas-checks.

Description of Material (40-pr.).

Section XI.

PROJECTILES.

				Weight.	
				lb.	oz.
Shells	{ Common*	empty.. ..	..	35	9½
		filled, with 2-lb 8-oz. bursting charge ..	..	38	1½
	{ Shrapnel*	filled, with 180 mixed metal bullets at 18 per lb., and 4½-oz. bursting charge ..	..	41	14
		Shot, case, filled with 405 mixed metal bullets, at 16½ per lb., clay and sand .. ..	..	38	6

N.B.—The common shell is bushed with gun-metal, as for larger natures of ordnance, but not countersunk.

CHARGE.

Service, serge, or silk cloth 7 R.L.G.

VELOCITY.

Average muzzle velocity 1,380 feet.

CARRIAGE AND LIMBER, MARK II.

The carriage is formed of two bracket sides, connected by transoms, bolts, and a trail piece with steeled eye, an axletree bed with 1st class axletree, and 5-feet siege wheels with metal naves.

Each bracket side is constructed of plate-iron, riveted to the inner side of an angle iron frame, and is provided with firing and travelling trunnion holes.

The axletree bed is of wrought-iron, constituting with the axletree a beam of box-girder section; it is connected to the brackets by stays.

The elevating gear is of the worm-wheel pattern; the gear is placed on the right side only, and consists of a "worm shaft" or "endless screw," with hand wheel, held in bearings on the outside of the carriage bracket, gearing into the teeth of a worm-wheel fitted with a friction clutch, giving motion to a pinion gearing into the teeth of the arc attached to the gun. The arc with its pinion is kept in position by a metal friction roller on the bracket. The wheel and screw are covered by a metal guard, made in two parts, and hinged together so as to give ready access to the wheel, &c.

A stool-bed of wood, strengthened by an iron plate along each side, large coin, hand coin, and scotch, are fitted to and issued with the carriages for use in laying the gun, in case of any damage to the elevating gear; the stool-bed also serves as "shifting plank" for the gun roller.

* These shells are fitted with gas-checks, weight about 20 oz.

Section XI.

Description of Material (40-pr.).

The carriage is fitted for hanging scales ; a pocket for priming irons is strapped on the rear transom.

The limber is formed on the same plan as the wood siege limber, but has the futchels and splinter bar of iron, with the axletree bed of wrought-iron instead of wood, and which with the axletree constitutes a beam of box-girder section. The wheels are the 2nd class field.

Instead of a pintail it is fitted with a limber hook, steeled to prevent wear, with a steel key.

The shafts are one pair "near" and "off," the former, being the "field" pattern, and the latter known as the Brandling pattern, fitted with loop, for stay of outrigger, and another pair framed. There are outriggers for 4-horse draught.

The limber boxes are "near" "off" and "centre;" the "near" and "off" carry each 6 projectiles and as many cartridges in a canvas cartouche.

The platform board is fitted with a box to contain hanging scales.

Height, centre of gun	..	..	..	..	ft.	in.
					4	5
Length of	{ carriage	{ with wheels	..	..	11	8
			without wheels	..	10	8
	{ axletree	{	..	..	6	3½
			carriage and	..	21	2
	{ limber	{ without gun	..	..	25	0
			with gun	..	25	0
Minimum space through which carriage can turn					36	0
Angle of trail	..	..	..	..	20°	
Elevation, maximum	..	..	..	..	35°	
Depression, maximum	..	..	..	..	5°	
Wheels	{ track	{	..	..	ft.	in.
			diameter	..	5	2
			..	..	5	0
Weight of	{	{	carriage, empty, with wheels,	..	cwts.	qrs. lbs.
			drag shoe, and arc, elevating	..	32	3 20
			limber, empty, with boxes,	..		
			shafts, and wheels	..	13	1 0
			wheels	..	10	2 0
			arc, elevating	..	0	0 26

OVERBANK CARRIAGE.

For siege purposes an overbank carriage is used. The "overbank" is the service pattern carriage fitted with a top of wrought-iron, a special elevating gear, arranged to depress 20° for loading, and a step for laying the gun.

The top is formed of two bracket sides connected by cross bolts, and secured to the carriage at the front by a strap bolt on each side of each bracket, and at the rear by clips and bolts. The

Description of Material (40-pr.).

Section XI

elevating arrangement consists of a worm-shaft and wheel, working an elevating pinion and arc by means of a friction cone. This gear is fixed at the front of the carriage between the brackets and is driven by a hand-wheel, the elevating arc being secured at each end to the underside of the gun.

The following is the method of removing the top :—

Depress the gun, detach the elevating arc, turn the hand-wheel of elevating gear until the teeth of the arc are clear of the pinion, when the arc can be removed from the rear and the gun dismounted. Take off the nuts and clip plates of the strap bolts and remove the rear clips and bolts, which will allow of the top being lifted off.

Weight of top	..	..	..	..	cwt.	qrs.
					9	2
Height to centre of gun at trunnions	..			..	ft.	in.
					6	3
Elevation	..	..	..	..		35°
Depression	..	..	..	..		5°

AMMUNITION WAGON.

The frame of the wagon (which is the same as 9, 16, or 25-pr.) consists of a perch of iron, with steeled eye and strengthening plates, two sides of angle iron, connected together by iron plates, over which the boards are secured, namely, two foot-boards and three platform.

The axletree bed is of wrought iron, and with the axletree constitutes a beam of box-girder section. The wheels are of the 2nd class, with metal naves.

The wagon is fitted with an iron block and arm, for carrying a spare wheel, and has also fittings for carrying a drag shoe and stores.

The ammunition boxes (four) stand between the platform boards secured by nib irons and straps; two are the same as the "near" gun limber box, and two the same as the "off," excepting lid fittings. Beneath the wagon are two under boxes.

The limber is similar to the gun limber, but not fitted with outriggers and framed shafts for 4-horse draught.

The boxes are identical with those of the gun limber.

Length of wagon and limber	..	..	..	..	ft.	in.
					20	7½
Minimum space through which wagon can turn	..	..	..	..	29	6½
Weight of wagon and limber, empty	..			..	cwt.	qrs. lbs.
(A. M.)					24	3 24

Section XI.

Description of Material (25-pr.).

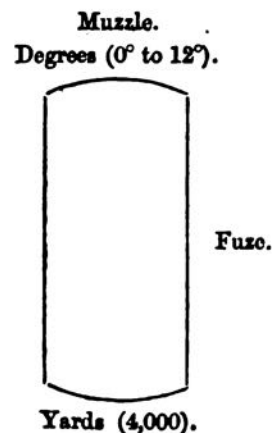
25-PR. RIFLED MUZZLE-LOADING GUN, OF 18 CWT.

DESCRIPTION.

Length	{ nominal ..	7 feet 10.5 inches.
	{ total ..	8 feet 2 inches.
	{ of bore ..	7 feet 4
	{ of rifling ..	6 feet 6 "
Preponderance (average) ..		7½ lbs.
Calibre		4 inches.
Weight (average) ..		17 cwt. 3 qrs. 17 lbs.
Twist of rifling, uniform ..		1 in 35 calibres.
Vent of hardened copper ..		1 inch from end of bore.

The gun is side-sighted only, viz. :—

Two tangent scales, set at an angle of 53' to the left to correct permanent deflection. The scale is four-sided, and has a gun-metal sliding leaf graduated to 30' for deflection in order to allow for wind or other irregularity, and a slow motion elevating nut under the cross head also, graduated round its circumference from 1 to 10 minutes, for finer adjustment in elevating. It is marked as follows :—



Two trunnion sights. These sights are of the ordinary service drop-sight pattern, and are identical with those of the 40-pr. rifled M.L. gun.

A clinometer is supplied for elevations above 12°.

PROJECTILES.

			Weight	
			lbs.	oz.
Shells	Common ..	{ empty ..	23	3
		{ filled, with 1½ lb. bursting charge ..	24	15½
	Shrapnel ..	{ filled, with 158 mixed metal bullets, 45 at 34 per lb., and 113 at 20 per lb., and 8 oz. bursting charge	25	0

Description of Material (25-pr.).	Section XI.
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Shot, case	{	filled, with 245 mixed metal bullets, at 16½ per lb., clay and sand	}	lbs. oz. 24 4
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CHARGES.

Service, serge or silk cloth .. 4 lb. R.L.G. powder.
 Exercise.

VELOCITY, AVERAGE.

1,320 feet (muzzle).

CARRIAGE AND LIMBER. MARK I.

The carriage is formed of two bracket sides, connected by transoms, bolts, and a trail piece; and an axletree bed with axletree and field wheels.

Each bracket side is constructed of plate iron riveted to the inner side of an angle iron frame.

The eye of trail piece is steeled to prevent wear.

The axletree bed is of wrought-iron, constituting with the axletree a beam of box-girder section. It is connected to the brackets by stays.

The wheels are the 2nd class field with metal naves.

The elevating gear is of the worm-wheel pattern, and is placed on the right side only; it consists of a "worm shaft" or "endless screw" with hand wheel, held in bearings on the outside of the carriage bracket, gearing into the teeth of a worm-wheel fitted with a friction clutch, giving motion to a wrought-iron pinion, gearing into the teeth of the arc attached to the gun; the arc with its pinion is kept in gear by means of a metal friction roller, fixed on the inside of the bracket of the carriage. The wheel and screw are covered by a metal guard, which forms the bearing for the wheel spindle, it is made in two parts, and hinged together so as to give ready access to the wheel, &c.

A stool bed of wood strengthened by an iron plate along each side, large coin, hand coin, and scotch are fitted to and issued with the carriage, for use in laying the gun in case of any damage to the elevating gear.

The carriage is fitted for the attachment of hanging scales, and the pocket for priming irons is strapped on the rear transom.

The axletree boxes are not fitted with guard irons or steps, and carry each 2 rounds of case and small stores.

The limber which is the Mark II. field limber is formed on the same plan as the wood limber, but has the futchels and splinter bar of iron.

The axletree bed is of wrought-iron instead of wood, and with the axletree constitutes a beam of box-girder section.

(A. M.)

K 2

Section XI.

Description of Material (25-pr.).

The limber hook is made to stand out from the bed, and so obviates the necessity of a block between them, it is steeled to prevent wear, and has a steel key.

The shafts are "near" and "off," the latter known as the Brandling pattern, and the limber is fitted for single, double, treble, and bullock draught.

The limber boxes are "near," "off," and "centre;" the near and off carry each 9 projectiles and as many cartridges in a canvas cartouche; each projectile is fitted with a lifting strap.

The foot-board is fitted with a box to contain the hanging scales.

Height, centre of gun					ft.	in.
Length of { carriage { with wheels					10	6
.. ..					9	3
.. ..					6	3½
.. ..					19	9½
.. ..					24	2¼
Minimum space through which carriages can turn					—	
Angle of trail					23°	
Elevation, maximum					45°	
Depression, maximum					5°	
Wheels { track					5'	2''
.. ..					5'	0''
Weight of { carriage, empty, with wheels, drag shoes, and arc, elevating.. ..					15	0 0
.. ..					11	1 0
.. ..					4	2 4
.. ..					0	0 17

AMMUNITION WAGON, MARK I.

The frame of the wagon consists of a perch of girder iron, with steeled eye, and two sides of angle iron, connected together by iron plates, over which the boards are secured, namely, two foot boards and three platform.

The axletree, which is the light field axletree, 2nd class, in its bed of wood, is bolted beneath the perch and sides.

The wheels of the wagon are the same as for the gun carriage.

The wagon is fitted with a sabicu block and arm for carrying a spare wheel, and has also fittings for carrying a drag shoe and stores.

The ammunition boxes (four) stand between the platform boards secured by nib irons and straps; two are the same as the "near" gun limber box, and two the same as the "off" excepting lid fittings. Beneath the wagon are two under boxes.

Description of Material (25-pr. and 7-pr.).

Section XI.

The limber (Mark I.) differs from the gun limber (Mark II.) in having a light field axletree and wood bed, instead of one forming a beam of box-girder section, and in the form of the limber hook, which is made to stand out from the bed by means of a block between them, and in not being fitted with a box for hanging scales.

Length of wagon and limber	ft.	in.
.. .. .	20	5½
Minimum space through which wagon can turn	29	8½
Weight of wagon and limber, empty	cwts.	qrs. lbs.
.. .. .	25	3 25

OVERBANK CARRIAGE.

For siege purposes an overbank carriage constructed to fire over a 5-feet 8-inch parapet is used. The "overbank" is the service pattern carriage fitted with a top of wrought-iron, a special elevating gear, arranged to depress 30° for loading, and a step for laying the gun.

The top is formed of two bracket sides connected by cross bolts, and secured to the carriage at the front by a strap bolt on each side of each bracket and at the rear by clips and bolts. The elevating arrangement consists of a wormshaft and wheel, working an elevating pinion and arc by means of a friction cone. This gear is fixed at the front of the carriage between the brackets and is driven by a hand-wheel, the elevating arc being secured at each end to the underside of the gun.

The following is the method of removing the top:—

Depress the gun, detach the elevating arc, turn the hand-wheel of elevating gear until the teeth of the arc are clear of the pinion; the arc can then be removed from the rear and the gun dismounted. Take off the nuts and clip plates of the strap bolts and remove the rear clips and bolts, which will allow the top to be lifted off.

Weight of top	cwts.	qrs.	lbs.
.. .. .	7	3	0
Height to centre of gun at trunnions	6	feet.	
Elevation	35°		
Depression	5°		

7-PR. RIFLED MUZZLE-LOADING STEEL GUN,
OF 200 LBS.

DESCRIPTION.

Length	{ nominal	33.9	inches.
	{ total	41	"
	{ of bore	36	"
	{ of rifling	34	"

Section XI.

Description of Material (7-pr.).

Preponderance (average) ¹	..	5 lbs.
Calibre	.. ..	3 inches.
Weight (average)	.. ..	201 lbs.
Grooves	.. ..	3
Twist of rifling, uniform	..	1 in 20.
Vent of hardened copper*	..	1 inch from bottom of bore.

The gun is sighted centrally and the tangent scale set at an angle of 3° to correct permanent deflection.

The following sights are provided with the gun:—

Two tangent scales of steel, graduated in degrees on one face and with yards and length of fuze on the other faces for charges of 4 oz., 8 oz., and 12 oz. respectively.

One sight reads from 0° to 8°, and the other from 0° to 12°.

The tangent scales are of the S.S. pattern, without deflection leaves.

One foresight, a small hogbacked sight, which screws into a recess in the dispart patch near the muzzle.

PROJECTILES.

				Weight.	
				lbs.	oz.
Shells, Double	.. {	empty	.. ..	11	0
		filled, with 1 lb. bursting charge	.. ..	12	0

CHARGES.

Service shalloon for double } 2 oz. F.G. or R.F.G. powder:
shell

If a 4-oz. charge is required, two 2-oz. charges may be used.

7-PR. BED.

This bed consists of two brackets of plate iron secured to a bottom plate by outside angle irons, and connected by a transom in front, and piece of angle iron in rear. Upon each bracket there is a handle.

Weight, 2 cwt.

* This vent bush is exceptional, having 18 threads to the inch and being only 0.625 in. diameter.

Description of Material (8-inch Howitzer).

Section XI.

8-INCH RIFLED MUZZLE-LOADING HOWITZER, OF
46 CWT.

			cwts.	qrs.	lbs.
Mean weight of howitzer	..	..	45	3	0
Mean preponderance	..	..	2	0	0
Length of piece (nominal)	..	..	61.25	in.	
" bore..	..	..	48.0		
" rifling	..	..	35.5		
Calibre ..	..	..	8.0		"
Number of grooves	..	..	4		

The rifling is on the Woolwich system, with a uniform twist of 1 turn in 16 calibres.

The termination of the rifling at a distance of 12.5 inches from the bottom of the bore acts as a stop in connection with the ribs on the gas check used with the projectile, so that a chamber of constant capacity is given in rear of the latter.

The grooves are splayed at the muzzle, and the edge of the latter is also rounded to facilitate loading.

The howitzer is provided with three sights, viz.:—

One steel tangent scale (set vertically) with a long steel cross-head and sliding leaf. The bar of the tangent scale is four-sided, and graduated as shown:—



The tangent scale is clamped by means of a moveable clamp.

A foresight screwed into the breech-coil and meant for use for elevation under 3°.

A muzzle sight of steel which is screwed to the piece by 3 screws.*

Planes for use with a quadrant are cut on the piece. Two for levelling, on the cascable and the upper surface of the breech coil, respectively, and one for elevation upon the top of the breech coil.†

* A preserving patch of cast-iron is supplied to preserve the part slotted out for reception of muzzle sight when travelling, &c.

† These planes are painted over for preservation from rust, and when required for practice care should be taken, in removing the paint, not to damage the edges of slotted portion.

Section XI.

Description of Material (8-inch Howitzer).

The howitzer is vented at an angle of $6^{\circ} 3'$ to the vertical, the vent striking the bore at 1.75 inch from the bottom.

One pivot piece, similar to that used with the 6.3-inch howitzer, complete with plate, elevating, steel pivot, keep pin, and 4 screws, is supplied with the howitzer.

8-INCH HOWITZER.

8-INCH HOWITZER.						Weight.	
						lbs.	oz.
Shell	{ Common	empty				165	8
		gas check				4	8
		plug for gas check				1	0½
		bursting charge				14	8
		total weight, filled				185	8½
		Star, filled with 21 stars, about				17	0
Shot, case, filled with 75 lb. 8-oz. sand shot, clay and sand						74	0

The common shell, in addition to the studs, is fitted with copper gas checks by a metal screw plug. The star shell consists of two hemispheres of wrought-iron 0.203 inch in thickness, riveted together, and filled with 21 stars of magnesium composition. The upper hemisphere is fitted with a socket for a wood time fuze, and the lower hemisphere is fitted with a wooden sabot for the purpose of centring the fuze in the bore of the howitzer. Charges, 10 lb., 5 lb. and 2½ lb.

The howitzer common shell may be used as an incendiary shell. They are then filled with incendiary composition instead of their ordinary bursting charge. Sufficient composition is supplied to fill 5 per cent. of the common shell with each unit of siege train.

8-INCH HOWITZER CARRIAGE, AND LIMBER.
MARK I.

This carriage is similar to the 40-pr. carriage, Mark II. It differs in having brackets of double plate construction with wrought iron frames, and in the axletree and its bed, which is formed merely by a piece of angle iron riveted along each side of the axletree, passing through instead of lying beneath the brackets, whilst a bottom plate is added extending from the rear transom to the breast of the brackets.

The plates of the brackets are $\frac{5}{16}$ inch thick, the rear transom has a forged piece riveted across the top in rear, and both transoms are secured by double angle iron.

The elevating gear is worked at the left side; it is similar to that of the 40-pr., and admits of 40° elevation being given to the howitzer.*

The limber is the same as the 64-pr. limber with a store box.

* From 6-lb. to 10-lb. charge, 20° is the extreme elevation that may be given if howitzer is mounted on this carriage with wheels on. Below 6-lb. charge up to 30° .

Description of Material (6·3-inch Howitzer).

Section XI.

6·3-INCH RIFLED MUZZLE-LOADING HOWITZER,
OF 18 CWT.

			cwts.	qrs.	lbs.
Mean weight of howitzer	..	..	17	2	20
„ preponderance	..	..	0	0	8*
Length of piece (nominal)	..	..			54-in.
„ „ bore	..	..			45 „
„ „ rifling	..	..			42·5 „
Calibre	..	..			6·3 „
Number of grooves	..	..			20

The form of groove is plain with rounded corners, and the twist is an increasing twist from 1 in 100 to 1 in 35 calibres.

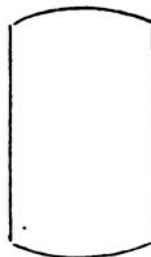
In this howitzer rotation is given by means of a ribbed gas-check of copper attached to the base of the projectile, and in order to stop the projectile always at the same point in the bore, a stop is put in the grooves at 5·3 in. from the breech end, giving a powder chamber of a constant capacity.

The grooves are splayed at the muzzle, and the edge of the latter is also rounded to facilitate loading.

The howitzer is provided with three sights, viz.:—

One steel tangent scale (set vertically) with a long steel cross head and sliding leaf. The bar of the tangent scale is four-sided and graduated as shown:—

Degrees.
0° to 15°.



The tangent scale is clamped by means of a moveable clamp.

A foresight screwed into the breech coil and meant for use for elevation under 3°.

A muzzle sight of steel which is screwed to the piece by three screws.†

Planes for use with a quadrant are cut on the piece. Two for levelling, on the cascable and the upper surface of the breech coil, respectively, and one for elevation upon the top of the breech coil.‡

The howitzer is vented vertically at 1·125 inch from the bottom of the chamber.

* Some of these pieces have a slight muzzle preponderance, the nominal preponderance being nil.

† A preserving patch of cast-iron is supplied to preserve the part slotted out for reception of muzzle sight, when travelling, &c.

‡ These planes are painted over for preservation from rust, and when required for practice care should be taken, in removing the paint, not to damage the edges of slotted portion.

Section XI. Description of Material (6.3-inch and 8-inch Howitzer).

One pivot piece, similar to that used with the 8-inch howitzer, complete with plate, elevating, steel pivot, keep pin, and four screws, is supplied with the howitzer.

				Weight.	
				lbs.	oz.
Shell	{ Common	complex .. ..	..	59	7
		gas-checks .. ..	..	1	14½
		plug for gas-check .. ..	..	1	0
		bursting charge .. ..	..	7	0
		total weight, filled .. ..	..	69	5½
	Star, filled with 21 stars, about .. ..		..	10	8

Shot, case (80-pr., 64-pr., or 6.3-inch howitzer), filled with 50 8-oz. sand shot, clay and sand, 49 lbs. 14½ oz.

The common shell is intended to be rotated by means of a gas-check only; it has no studs. It has eight wedge-shaped radial grooves cast in the base, as shown in the plate. The gas-check is fitted with projections to enter the grooves of the rifling, and is fixed to the shell by a gun-metal plug; it has also projections to fit into the radial grooves on the base of the shell, by which means the rotation of the gas-check given by the rifling is communicated to the shell.

The star-shell is of the same description as the 8-inch howitzer shell, but is 0.165 inch in thickness.

Charges, 4 lbs., 3 lbs., 2 lbs., and 1 lb.

6.3-INCH HOWITZER, CARRIAGE AND LIMBER.

The carriage for the 6.3-inch howitzer is the 40-pr. carriage, Mark II., fitted with a special elevating arc and two additional pinions in the elevating gear, one of which gears into the pinion of the 40-pr. gear.

The limber carries the same store box as the 64-pr. limber.

BED, IRON, WROUGHT, RIFLED M.L. 8-INCH OR 6.3-INCH HOWITZER.

The beds for 8-inch and 6.3-inch howitzers are the same in general construction, but differ in points of detail.

The bed is fitted with elevating and compressor gear, and has a guide or directing bar to facilitate training and to check the recoil. It is mounted on a ground platform of special construction, and is fitted for transport by means of a transporting axle and wheels, and a limber (or dilly) fitted for horse draught. The bed has double plate brackets connected by a bottom plate and front and rear transoms; the bottom is cranked to allow room for the guide bar to pass beneath the bed longitudinally.

The bed is supported on six metal rollers that remain always in action.

Description of Material (6·3-inch or 8-inch Howitzer). Section XI.

The elevating gear consists of an endless screw and worm-wheel, placed on the outside of the right-hand bracket only, and connected with the elevating arc by a toothed pinion. The worm-wheel is fitted with a friction cone to reduce the strain of the teeth when the gun is fired, and must be set up by means of the nuts on the end of the spindle so as to allow a slight slip at each round.

The bed allows of elevation from 0° to 45° .*

The compressor gear consists of a bow or cramp, resting on the bottom of the bed, and fitted with a screw and lever at each end for adjustment and compression, by which three hanging plates on each side are forced against the sides of the guide bar and compressor bars supported on it; the inner hanging plate on each side is formed with a clip, to prevent the bed rising above the guide bar. The compressing screw with lever is fixed on the left side, and the adjusting screw with lever on the right side.

The guide or directing bar is made of channel and plate iron; it is fitted in front with a hinged flap, for securing to a pivot on the ground platform, and has front and rear stops and two horns at the rear end for traversing. The rear end is also fitted to receive the pintail of the limber for transporting. The front of the guide bar is slightly tapered to allow the carriage to recoil 2 feet before the compressor comes fully into action; the sides are arranged to allow the bed to jump the height of the bar at the commencement of the recoil, and two compressor bars are attached to each side for use in conjunction with the cramp compressor.

The following are the principal points of difference between the 8-inch and 6·3-inch howitzer beds:—

	8-inch.	6·3-inch.
	feet inch.	feet inch.
Height to centre of gun above the ground platform ..	2 6	3 0·5
Width between brackets	2 3·625	1 7·937
" of guide bar	0 10	0 8
Length of bow cramp	1 6	1 4
Elevating pinions No.	1	3

GROUND PLATFORM FOR USE WITH BED, IRON, WROUGHT, RIFLED M.L. 8-INCH OR 6·3-INCH HOWITZER.

The platform is of oak, and consists of two side baulks, dovetailed and bolted to two transoms, and two centre baulks housed into the same transoms. The front transom is fitted with a pivot, for the attachment of the guide bar of the howitzer bed; the pivot and the four bolts which secure it pass through the transom and are fastened on the under side by keys.

* With 8-inch howitzer bed for charges up to 10 lb., an elevation of from 20° to the maximum angle obtainable is allowed.

Section XI. Description of Material (6.3-inch or 8-inch Howitzer).

The portion of the platform occupied by the bed when in position for fixing is plated with sheet iron to protect it from the wear of the bed rollers, and a grooved plate is let into the rear transom to facilitate the traversing of the guide bar by a handspike. The outer ends of the transoms and the ends of side baulks are hooped to preserve them from splitting.

The platform will allow of the howitzer bed being traversed 5° to right or left of centre.

TO ADJUST AND WORK THE COMPRESSOR.

Before commencing practice, run the bed back about 3 feet from the front stop and adjust the compressor by means of the adjusting screw* and lever, till one man exerting his whole power on the compressor lever can just force it past the catch; then secure the adjusting lever by the key; release the compressing lever, and run up for firing.

Should the recoil be found to be too violent, the adjusting lever must be moved one or more holes towards the front of bed, and again secured by the key. If the lever is found to be too far to the front to give the required adjustment, remove the nut and collar of the screw, take off the lever, turn it to the rear until it can be replaced on the next position of the hexagon of the screw, and secure it with the nut and collar.

Should the recoil be less than required, the above directions should be carried out in the reverse order.

TO RUN-UP.

Release the compressing lever on left side, lifting it past the catch of the arc and to the front stop.

As the compressor is not self-acting, great care must be taken that the compressor lever is always pressed down past the catch, before each round, as soon as the howitzer is run up.

FUZES.

The following fuzes are used for shells of siege train:—

Fuze, percussion	{ sensitive. R.L.	
Fuze, time {	30-secs.	{ The 20, 9 and 5-secs. fuzes will be replaced by the 30 and 15-secs.
	20-secs.	
	15-secs.	
	9-secs.	
	5-secs.	

The sensitive percussion fuze, which is more easily set in action than the R.L. percussion fuze, is for use with 7-pr. gun and the two howitzers.

* For no other purpose than adjustment should the adjusting lever be moved. It is tightened by moving it to the "front," and slackened by moving it towards the "rear."

Detail of Siege Train.

Section XII.

Section XII.—Detail of a Siege Train, Royal Artillery [War Establishment].

A siege train will consist of any number of units, composed of heavy or light ordnance, according to the requirements of the Service, each unit consisting of the following personnel and guns with 500 rounds of ammunition per gun, and stores in proportion.

I. DETAIL OF ARTILLERY OFFICERS AND MEN REQUIRED FOR ONE HEAVY OR LIGHT UNIT OF A SIEGE TRAIN.

The Artillery will consist of Eight Batteries, with the following Establishment:—

Establishment.	One Battery.	Total for Eight Batteries.
OFFICERS:		
Majors	1	8
Captains	1	8
Lieutenants	2	16
	4	32
NON-COMMISSIONED OFFICERS AND MEN:		
Battery Serjeant-Major.. .. .	1	8
Serjeants	5	40
Corporals	5	40
Bombardiers	5	40
Gunners	120	960
Trumpeters	2	16
	138	1,104
Total	142	1,136

II. DETAIL OF ORDNANCE, BEDS, AND CARRIAGES FOR A HEAVY SIEGE TRAIN UNIT.

Description.	No.	Proportions, and how mounted.
Ordnance, rifled M.L., with sights, &c.*	<div> <div>guns {</div> <div>64-pr., 64 cwt.</div> <div>40-pr., 35 cwt.</div> <div>howitzers, 8-inch, 46 cwt. ..</div> </div>	<div> <div>Siege travelling carriages and platform wagons.</div> <div>Siege travelling carriages.</div> <div>{ Siege travelling carriages.</div> <div>{ 7 also provided with beds.</div> </div>
Total ordnance	30	
<i>Beds and Carriages for Ordnance, complete.</i>		
Beds, howitzer, 8-inch	7	1 to 2 howitzers.
Carriages, iron, wrought, travelling, rifled M.L., siege, with limbers ..	<div> <div>gun† {</div> <div>64-pr.</div> <div>40-pr.</div> <div>howitzer, 8-inch</div> </div>	<div> <div>1 spare to 8 carriages.</div> <div>Do. do.</div> <div>1 spare to 14 carriages.</div> </div>
Total carriages and beds	40	

* Each piece is supplied with pivot pieces complete both for siege and overbank carriages.

† The gun carriages are fitted with tops for overbank fire.

Section XII.

Detail of Siege Train.

II. DETAIL OF ORDNANCE, BEDS, AND CARRIAGES—*continued.*

Description.		No.	Proportions, and how mounted.
<i>Carriages for Transport, complete.</i>			
Carts, trench	.. .. .	15	1 to 2 pieces of ordnance.
	ammunition and store	60	2 per piece of ordnance.
	platform	12	1 per 64-pr. gun, and 4 for gyny and stores.
Wagons	slings, wood, service*	3	1 to 10 pieces of ordnance.
	with limbers { forge, with forge		
	complete†	3	1 to 10 pieces of ordnance.
	store‡	3	1 to 10 pieces of ordnance.
Total carts and wagons		96	

III. DETAIL OF ORDNANCE AND CARRIAGES FOR A LIGHT SIEGE TRAIN UNIT.

Ordnance, rifled M.L., with sights, &c. § ..	{ guns { 40-pr., 35 cwt. .. 25-pr., 18 cwt. .. howitzer, 6.3-inch, 18 cwt. ..	10 10 10	} Siege travelling carriages.	
Total ordnance		30		
<i>Beds and Carriages for Ordnance, complete.</i>				
Beds, howitzer, 6.3-inch, with limbers, transporting		5	1 to 2 howitzers.	
Carriages, iron, wrought, travelling, rifled M.L., with limbers ..	{ field { gun || { 40-pr. .. and { 25-pr. .. siege { howitzer, 6.3-inch ..	11 11 11	} 1 spare to 10 carriages of each nature.	
Total carriages and beds		38		
<i>Carriages for Transport, complete.</i>				
Carts, trench		15	1 to 2 pieces of ordnance.	
Wagons {	ammunition and store	60	2 per piece of ordnance.	
	platform	2	For gys and stores.	
	with limbers {	forge, ‡ with forge complete	3	1 to 10 pieces of ordnance.
		store, ‡	3	1 to 10 pieces of ordnance.
Total carts and wagons		83		

With each of the above units will be associated—

Six 7-pr. rifled M.L. steel guns of 200 lb., on wrought-iron beds,¶ carried in additional ammunition and store wagons.

300 24-pr. Hale's rockets, with 6 troughs, and proportion of tubes (380) and lanyards (12), carried in ammunition and store wagons.

* Complete with 4 levers (2 of which are fitted with ropes), 1 breech lashing, 30 feet long, of 2½-inch tarred rope, 1 sling, 9 feet long from bight to bight, of 5-inch white rope, 2 large and 2 small thimbles, 2 pawls of ash, a wooden cleat, 5 swingle-trees, and drag shoe and chain.

† When converted forge wagons with old pattern bellows forge are supplied, 3 additional A. and S. wagons per unit will be required.

‡ When store limber-up wagons are not supplied, 3 A. and S. wagons will be required in place of them.

§ Each piece is supplied with pivot pieces complete both for siege and overbank carriages.

|| These carriages are fitted with tops for overbank fire.

¶ One spare bed in addition.

Detail of Siege Train.

Section XII.

Packing of Ammunition { All cartridges to be carried filled, and, except in the case of those in the limber and axletree boxes, packed in metal lined cases.
All shells are to be filled, and, together with the case shot, carried in wooden boxes, with the exception of those packed in limbers and axletree boxes.

LIST OF STORES REQUIRED FOR LANDING GUNS UP TO 90 CWT.

The head of sheers connected with bolt and keep pin, hook, and chain for main tackle, and two shackles for guys.

Description of Stores.		No.	For what Purpose.
Axes, pick-helved ..		4	General purposes.
Blocks, wood	Bothways { treble, 12-inch ..	4	2 for main tackle fall, 2 for guys.
	double, ..	2	Guys.
	Admiralty, iron bound { snatch.. ..	3	1 leading at feet of sheers. 2 leading running end of guys.
Cordage	4-inch fathoms	226	Guys.
	2½-inch { 10 fathoms	1	Guy of lever for raising sheers.
	12 fathoms	2	Steadying weight.
	6 fathoms	1	Securing block at foot of sheers.
	1½-inch 5 fathoms	36	Lashing pickets, &c.
yarn, spun lb.		2	Housing, &c.
	white hawser, 3-strand 4-in. fathoms	113	Main tackle fall.
Capstan, crab, complete		3	One for weight, others for guys.
Handspikes, common, bevelled { 6-feet ..		6	General purposes.
	7-feet ..	6	
Levers, wood, 14-feet		1	Raising sheers.
Mauls, wood, iron-hooped, helved		6	Driving pickets, &c.
Planks, oak { 6 feet x 12 in. x 3 in. ..		6	General purposes.
	4 feet x 12 in. x 3 in. ..	6	
Postpicket, garrison, 5-feet		36	Holdfasts.
Ropes { wire, steel, 22 feet each ..		6	Guys, &c.
	gasket, 4-in., tarred, 2½ fathoms each ..	2	Stoppering fall.
Scotches, wood { medium		12	General purposes.
	small	12	
Selvagees		6	Securing leading blocks, &c.
Shoes or Steps		2	Sheers, or derricks, feet of.
Skids, wood, oak { 3 feet x 9 inches x 9 inches ..		6	General purposes.
	3 " x 6 " x 6 " ..	4	
	3 " x 6 " x 8 " ..	4	
	3 " x 4 " x 4 " ..	4	
	3 " x 3 " x 3 " ..	4	
Slings, white rope { 12 feet x 6 inches ..		3	2 securing capstan. 1 slinging gun.
	4 " x 4 " ..	2	Securing standing blocks of guys.
Spades, common		4	General purposes.
Tackles, luff, complete, sets		2	Feet of sheers.
Timber, 40 feet long, 13 inches mean diameter..		2	Sheers and derricks, spars for.

Section XIII.

Range Tables.

Section XIII.—Range Tables.

Range Table for 8-inch B.M.L. Howitzer.

Projectile, common shell and gas-check, 185-lb.

Charges, 2 and 3-lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.	Deflection.	Value of 5 minutes.		Time of flight.
				Elevation. in range.	Deflection.	
yards.	yards.	° ' "	° ' "	yards.	yards.	seconds.
<i>2-lb. charge.</i>						
400	11.0	18 15	1 42	2.00	0.56	5.4
500	14.5	24	1 44	1.44	0.70	6.9
600	22.0	35	2 12	0.75	0.83	9.6
<i>3-lb. charge.</i>						
400	7.5	10 45	1 8	3.8	0.56	4.0
500	9.3	18 50	1 8	3.5	0.70	4.9
600	11.6	16 15	1 10	2.9	0.83	5.9
700	14.5	19 30	1 15	2.6	0.97	7.0
800	18.2	23 45	1 22	2.1	1.11	8.4
900	23.2	29	1 33	1.6	1.25	10.2
1000	33.2	38	2	0.9	1.39	12.0

Range Tables.

Section XIII.

Range Table for 8-inch R.M.L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charges, 4 and 5 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.	Deflection.	Value of 5 minutes.		Time of flight.
				Elevation. In range.	Deflection.	
yards.	yards.	° ' ''	° ' ''	yards.	yards.	seconds.
<i>4-lb. charge.</i>						
400	5.0	8	0 45	6.3	0.56	3.5
500	6.5	9 30	0 46	5.6	0.70	4.2
600	8.3	11 10	0 49	5.0	0.83	4.9
700	10.2	13	0 52	4.5	0.97	5.6
800	12.4	15	0 56	4.2	1.11	6.4
900	15.0	17 20	1	3.6	1.25	7.1
1000	18.0	20	1 4	3.1	1.39	8.5
1100	22.0	23	1 12	2.8	1.53	9.7
1200	28.0	27 15	1 24	2.0	1.67	11.3
1300	35.0	32	1 36	1.7	1.80	13.0
1400	45.0	38 15	1 58	1.3	1.94	15.2
<i>5-lb. charge.</i>						
400	3.5	5 40	0 31	7.1	0.56	2.0
500	5.0	7	0 36	6.3	0.70	3.5
600	6.5	8 20	0 39	6.3	0.83	4.2
700	8.0	9 45	0 41	6.0	0.97	4.9
800	10.0	11 10	0 45	6.0	1.11	5.6
900	12.0	12 45	0 48	5.3	1.25	6.3
1000	14.3	14 30	0 51	4.8	1.39	7.1
1100	16.8	16 15	0 55	4.8	1.53	8.0
1200	20.0	18 25	1	3.8	1.67	9.0
1300	23.5	20 35	1 5	3.8	1.80	10.0
1400	27.5	23	1 10	3.5	1.94	11.0
1500	32.5	26	1 17	2.8	2.08	12.2
1600	39.5	29 30	1 28	2.4	2.22	13.7
1700	48.0	33 30	1 41	2.1	2.36	15.3
1800	61.0	39	2 2	1.5	2.50	17.4

Section XIII.

Range Tables.

Range Table for 8-inch R.M.L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charge, 6 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.		Deflection.		Value of 5 minutes.		Time of flight.
						Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	1.50	4	30	0	13	7.7	0.56	2.6
500	3.00	5	35	0	22	7.7	0.70	3.2
600	4.75	6	45	0	28	7.1	0.83	3.8
700	6.50	7	55	0	33	7.1	0.97	4.4
800	8.50	9	5	0	33	7.1	1.11	5.0
900	10.50	10	15	0	42	7.1	1.25	5.7
1000	12.50	11	30	0	45	6.7	1.39	6.4
1100	14.75	12	50	0	48	6.2	1.53	7.1
1200	17.25	14	15	0	51	5.9	1.67	7.8
1300	20.00	15	45	0	55	5.5	1.80	8.6
1400	22.75	17	15	0	58	5.5	1.94	9.4
1500	26.00	18	55	1	2	5.0	2.08	10.2
1600	29.75	20	45	1	7	4.5	2.22	11.1
1700	33.75	22	45	1	11	4.1	2.36	12.1
1800	38.75	25		1	17	3.7	2.50	13.1
1900	44.75	27	30	1	25	3.3	2.64	14.3
2000	52.25	30	25	1	34	2.9	2.78	15.6
2100	62.00	33	45	1	46	2.5	2.92	17.1
2200	81.00	39		2	12	1.5	3.06	19.3

Range Tables.

Section XIII.

Range Table for 8-inch R.M.L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charge, 7 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.		Deflection.		Value of 5 minutes.		Time of flight.
						Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	0.5	3	25	0	4	9.1	0.56	2.1
500	2.0	4	20	0	14	9.1	0.70	2.7
600	3.6	5	20	0	21	8.3	0.83	3.3
700	5.3	6	20	0	27	8.3	0.97	3.9
800	7.1	7	20	0	31	8.3	1.11	4.5
900	8.9	8	20	0	35	8.3	1.25	5.1
1000	10.8	9	20	0	38	8.3	1.39	5.7
1100	12.8	10	20	0	41	8.3	1.53	6.3
1200	14.8	11	25	0	44	8.0	1.67	6.9
1300	17.0	12	35	0	47	7.1	1.80	7.6
1400	19.5	13	45	0	50	7.1	1.94	8.2
1500	22.0	14	55	0	53	7.1	2.08	8.9
1600	25.0	16	15	0	56	6.3	2.22	9.6
1700	28.5	17	35	1		6.3	2.36	10.4
1800	32.0	19	5	1	4	5.5	2.50	11.2
1900	36.0	20	40	1	8	5.2	2.64	12.0
2000	40.0	22	25	1	12	4.8	2.78	12.9
2100	45.5	24	25	1	18	4.2	2.92	13.9
2200	52.0	26	30	1	25	4.0	3.06	15.0
2300	60.0	28	50	1	33	3.6	3.20	16.2
2400	70.0	31	30	1	45	3.1	3.34	17.6
2500	85.0	35		2	2	2.6	3.48	19.2
2600	106.0	38	40	2	27	2.3	3.61	20.8

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Section XIII.

Range Tables.

Range Table for 8-inch R. M. L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charge, 8 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Dri't.	Elevat'on.	Deflection.	Value of 5 minutes.		Time of flight.
				Elevation. In range.	Deflection.	
yards.	yards.	° ' "	° ' "	yards.	yards.	seconds.
400	1.3	3 5	0 11	10.0	0.56	2.1
500	2.5	3 55	0 18	10.0	0.70	2.7
600	3.9	4 45	0 23	10.0	0.83	3.3
700	5.5	5 35	0 28	10.0	0.97	3.8
800	7.1	6 25	0 31	10.0	1.11	4.3
900	8.8	7 25	0 35	10.0	1.25	4.9
1000	10.6	8 10	0 38	10.0	1.39	5.4
1100	12.5	9 5	0 40	9.1	1.53	6.0
1200	14.4	10	0 43	9.1	1.67	6.6
1300	16.4	10 55	0 45	9.1	1.80	7.2
1400	18.6	11 50	0 47	9.1	1.94	7.8
1500	20.9	12 45	0 50	9.1	2.08	8.3
1600	23.3	13 45	0 52	8.3	2.22	8.9
1700	25.8	14 45	0 54	8.3	2.36	9.5
1800	28.4	15 45	0 56	8.3	2.50	10.1
1900	31.4	16 50	0 59	8.0	2.64	10.8
2000	34.8	18	1 2	7.1	2.78	11.5
2100	38.8	19 20	1 6	6.6	2.92	12.2
2200	43.0	20 40	1 10	6.6	3.06	13.0
2300	47.5	22 5	1 14	6.3	3.20	13.8
2400	53.0	23 35	1 19	5.9	3.34	14.7
2500	59.0	25 20	1 24	4.7	3.48	15.6
2600	67.0	27 10	1 32	4.5	3.61	16.6
2700	76.0	29 20	1 41	3.8	3.75	17.7
2800	89.0	31 45	1 54	3.5	3.89	19.0
2900	107.0	35	2 12	2.6	4.03	20.6
3000	135.0	39	2 42	2.1	4.17	22.5

Range Tables.

Section XIII.

Range Table for 8-inch R.M.L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charge, 9 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.		Deflection.		Value of 5 minutes		Time of flight.
						Elevation. in range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	0.5	2	10	0	4	12.5	0.56	1.7
500	1.7	2	55	0	12	11.1	0.70	2.2
600	3.0	3	40	0	18	11.1	0.83	2.7
700	4.4	4	25	0	22	11.1	0.97	3.2
800	5.8	5	10	0	26	11.1	1.11	3.7
900	7.3	5	55	0	29	11.1	1.25	4.2
1000	8.8	6	40	0	31	11.1	1.39	4.7
1100	10.4	7	25	0	34	11.1	1.53	5.2
1200	12.1	8	15	0	36	10.0	1.67	5.8
1300	14.0	9	5	0	38	10.0	1.80	6.4
1400	16.0	9	55	0	41	10.0	1.94	7.0
1500	18.1	10	45	0	43	10.0	2.08	7.6
1600	20.3	11	35	0	45	10.0	2.22	8.1
1700	22.5	12	25	0	47	10.0	2.36	8.7
1800	25.0	13	20	0	50	9.1	2.50	9.3
1900	27.8	14	25	0	52	9.1	2.64	9.9
2000	30.8	15	20	0	55	9.1	2.78	10.5
2100	34.0	16	15	0	58	9.1	2.92	11.1
2200	37.5	17	15	1	1	8.3	3.06	11.7
2300	41.2	18	15	1	4	8.3	3.20	12.3
2400	45.0	19	15	1	7	8.3	3.34	12.9
2500	50.0	20	30	1	12	8.0	3.48	13.6
2600	55.0	21	40	1	16	7.1	3.61	14.4
2700	61.5	23	5	1	22	5.9	3.75	15.2
2800	69.0	24	35	1	28	5.5	3.89	16.1
2900	77.5	26	15	1	36	5.0	4.03	17.1
3000	88.5	28	5	1	46	4.5	4.17	18.1
3100	102.0	30	10	1	58	4.0	4.31	19.3
3200	119.0	33	30	2	13	3.6	4.44	20.6
3300	141.0	35	15	2	33	3.0	4.58	22.0
3400	168.0	38	30	2	57	2.6	4.72	23.7

Section XIII.

Range Tables.

Range Table for 8-inch R.M.L. Howitzer.

Projectile, common shell and gas-check, 185 lb.

Charge, 10 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift.	Elevation.		Deflection.		Value of 5 minutes.		Time of flight.
						Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	0.9	2		0	8	14.3	0.56	1.7
500	1.8	2	35	0	13	14.3	0.70	2.1
600	2.8	3	10	0	17	14.3	0.83	2.6
700	4.0	3	50	0	21	12.5	0.97	3.1
800	5.3	4	30	0	24	12.5	1.11	3.6
900	6.6	5	10	0	26	12.5	1.25	4.1
1000	8.0	5	50	0	29	12.5	1.39	4.6
1100	9.5	6	30	0	31	12.5	1.53	5.1
1200	11.0	7	10	0	33	12.5	1.67	5.6
1300	12.7	7	50	0	35	12.5	1.80	6.1
1400	14.5	8	35	0	37	11.1	1.94	6.6
1500	16.4	9	20	0	39	11.1	2.08	7.1
1600	18.5	10	5	0	42	11.1	2.22	7.6
1700	20.7	10	55	0	44	11.1	2.36	8.1
1800	22.9	11	35	0	46	11.1	2.50	8.6
1900	25.2	12	20	0	48	11.1	2.64	9.1
2000	27.6	13	5	0	50	11.1	2.78	9.6
2100	30.6	13	55	0	52	10.0	2.92	10.2
2200	33.7	14	45	0	55	10.0	3.06	10.8
2300	37.3	15	35	0	58	10.0	3.20	11.3
2400	41.5	16	30	1	2	9.1	3.34	11.9
2500	45.5	17	25	1	6	9.1	3.48	12.5
2600	51.0	18	25	1	11	8.3	3.61	13.1
2700	57.0	19	25	1	16	8.3	3.75	13.7
2800	64.0	20	30	1	23	8.0	3.89	14.4
2900	72.0	21	40	1	29	7.1	4.03	15.2
3000	81.0	22	50	1	37	7.1	4.17	16.0
3100	90.0	24		1	45	7.1	4.31	16.7
3200	100.0	25	15	1	53	6.6	4.44	17.4
3300	111.0	26	45	2	1	5.5	4.58	18.3
3400	123.0	28	25	2	10	5.0	4.72	19.3
3500	137.0	30	15	2	21	4.5	4.86	20.4
3600	154.0	32	25	2	33	3.8	5.00	21.6
3700	176.0	35		2	51	3.2	5.13	23.1
3800	204.0	38	15	3	11	2.6	5.27	24.9

Range Tables.

Section XIII.

Range Table for 6·3-inch R.M.L. Howitzer.

Projectile, common shell weighted = 70 lb., including gas-check.

Charge, 2 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift. Right.	Elevation.		Deflection. Left.	Value of 5 minutes.		Time of flight.
					Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	seconds.
400	—	4	30	—		7·1	0·56
500	0·5	5	45	0	4	7·1	0·70
600	1·8	7		0	11	7·1	0·83
700	3·5	8	15	0	18	6·7	0·97
800	5·5	9	35	0	25	6·3	1·11
900	7·7	11		0	31	5·9	1·25
1000	10·2	12	30	0	37	5·6	1·39
1100	13·0	14	5	0	43	5·3	1·53
1200	16·5	15	45	0	49	5·0	1·67
1300	20·0	17	30	0	55	4·8	1·81
1400	24·0	19	20	1	2	4·5	1·95
1500	28·5	21	15	1	9	4·3	2·09
1600	33·6	23	15	1	16	4·1	2·13
1700	40·0	25	30	1	25	3·7	2·27
1800	47·2	28		1	34	3·3	2·41
1900	57·3	31		1	49	2·8	2·55
2000	72·0	35		2	10	2·1	2·69
2100	91·8	40		2	37	1·7	2·91

Section XIII.

Range Tables.

Range Table for 6·3-inch R.M.L. Howitzer.

Projectile, common shell weighted = 70 lb., including gas-check.

Charge, 3 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift. Right.	Elevation.		Deflection. Left.		Value of 5 minutes.		Time of flight.
						Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	—	2	20	—	—	9·1	0·56	1·7
500	0·5	3	15	0	4	9·1	0·70	2·3
600	1·0	4	10	0	6	9·1	0·83	2·9
700	2·1	5	5	0	11	9·1	0·97	3·6
800	3·3	6		0	14	9·1	1·11	4·2
900	4·5	6	55	0	17	9·1	1·25	4·8
1000	5·8	7	50	0	20	9·1	1·39	5·4
1100	7·1	8	45	0	23	9·1	1·53	6·0
1200	8·5	9	40	0	26	9·1	1·67	6·6
1300	10·2	10	35	0	29	9·1	1·81	7·2
1400	12·4	11	30	0	32	9·1	1·95	7·8
1500	14·6	12	35	0	35	9·1	2·09	8·3
1600	16·9	13	20	0	38	9·1	2·13	8·9
1700	19·2	14	20	0	41	8·3	2·27	9·5
1800	22·0	15	20	0	44	8·3	2·41	10·1
1900	25·0	16	25	0	47	7·7	2·55	10·8
2000	28·2	17	35	0	50	7·1	2·69	11·5
2100	31·5	18	45	0	54	7·1	2·91	12·2
2200	35·5	20		0	58	6·7	3·10	12·9
2300	40·0	21	20	1	3	6·3	3·19	13·6
2400	45·0	22	50	1	8	5·6	3·33	14·4
2500	51·0	24	30	1	14	5·0	3·47	15·4
2600	58·2	26	15	1	21	4·8	3·61	16·4
2700	66·0	28	15	1	28	4·1	3·75	17·5
2800	75·0	30	30	1	36	3·7	3·89	18·7
2900	85·6	33		1	46	3·3	4·03	20·0
3000	99·0	36		1	59	2·8	4·17	21·6
3100	126·0	39	40	2	26	2·3	4·30	23·5

Range Tables.

Section XIII.

Range Table for 6.3-inch R.M.L. Howitzer.

Projectile, common shell weighted = 70 lb., including gas-check.

Charge, 4 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Range.	Drift. Right.	Elevation.		Deflection. Left.		Value of 5 minutes.		Time of flight.
						Elevation. In range.	Deflection.	
yards.	yards.	°	'	°	'	yards.	yards.	seconds.
400	—	1	45	0	0	16.7	0.56	1.7
500	0.3	2	15	0	2	16.7	0.70	2.1
600	0.8	2	50	0	5	14.3	0.83	2.5
700	1.5	3	25	0	8	14.3	0.97	3.0
800	2.3	4		0	10	14.3	1.11	3.5
900	3.0	4	35	0	12	14.3	1.25	3.9
1000	4.0	5	10	0	14	14.3	1.39	4.4
1100	5.0	5	45	0	16	14.3	1.53	4.9
1200	6.0	6	20	0	18	14.3	1.67	5.3
1300	7.3	6	55	0	20	14.3	1.81	5.7
1400	8.5	7	30	0	22	14.3	1.95	6.1
1500	10.0	8	5	0	24	14.3	2.09	6.6
1600	12.0	8	45	0	27	12.5	2.13	7.1
1700	14.0	9	25	0	30	12.5	2.27	7.6
1800	16.0	10	5	0	32	12.5	2.41	8.1
1900	18.3	10	45	0	35	12.5	2.55	8.6
2000	20.5	11	30	0	37	11.2	2.69	9.2
2100	23.0	12	15	0	39	11.2	2.91	9.7
2200	25.8	13		0	42	11.2	3.10	10.2
2300	28.8	13	45	0	45	11.2	3.19	10.8
2400	31.8	14	30	0	48	11.2	3.33	11.3
2500	35.0	15	15	0	51	11.2	3.47	11.9
2600	39.0	16	5	0	54	10.0	3.61	12.5
2700	43.3	17		0	57	9.1	3.75	13.1
2800	48.0	18		1		8.4	3.89	13.8
2900	53.0	19		1	5	8.4	4.03	14.5
3000	58.3	20		1	10	8.4	4.17	15.2
3100	63.8	21		1	14	8.4	4.30	15.8
3200	69.2	22		1	18	8.4	4.44	16.5
3300	75.0	23	5	1	22	7.7	4.58	17.2
3400	81.5	24	10	1	26	7.7	4.72	18.0
3500	88.6	25	25	1	31	6.6	4.86	18.8
3600	96.0	26	45	1	36	6.3	5.00	19.6
3700	104.0	28	15	1	41	5.5	5.14	20.6
3800	123.0	29	45	1	56	5.5	5.28	21.6
3900	135.0	31	45	2	5	4.2	5.42	22.8
4000	152.0	35		2	17	2.6	5.56	24.9
4100	180.0	39	30	2	38	1.9	5.70	27.6

Section XIII.

Range Tables.

Range Table for 64-pr. R.M.L. Gun of 64 cwt.

Projectile, battering, with gas-check, 90 lb.

Charge, 12 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Distance of Object.	Elev.	Distance of Object.	Elev.	Distance of Object.	Elev.
yds.	° '	yds.		yds.	
100	—	2600		5100	
200	—	2700		5200	
300	—	2800		5300	
400	0 10	2900		5400	
500	0 23	3000		5500	
600	0 36	3100		5600	
700	0 50	3200		5700	
800	1 4	3300		5800	
900	1 18	3400		5900	
1000	1 33	3500		6000	
1100	1 48	3600		6100	
1200	2 3	3700		6200	
1300	2 18	3800		6300	
1400	2 33	3900		6400	
1500	2 48	4000		6500	
1600	3 3	4100		6600	
1700	3 18	4200		6700	
1800	3 34	4300		6800	
1900	3 50	4400		6900	
2000	4 6	4500		7000	
2100	4 22	4600		7100	
2200	4 38	4700		7200	
2300	4 54	4800		7300	
2400	5 11	4900		7400	
2500	—	5000		7500	

Range Tables.

Section XIII.

Range Table for 64-pr. R.M.L. Gun.

Projectile, common shell, weight 64.5 lb.

Charge, 10 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.
yds.	° ' "	secs.		yds.	° ' "	secs.		yds.			
100	0 7	0.25	—	2500	5 23	7.26	16	5100			
200	0 16	0.48	1	2700	5 40	7.7	17	5200			
300	0 25	0.72	1.5	2800	5 58	8.04	17	5300			
400	0 34	0.96	2	2900	6 16	8.39	18	5400			
500	0 43	1.21	2.5	3000	6 34	8.74	19	5500			
600	0 52	1.46	3.5	3100	6 53	9.09	19	5600			
700	1 2	1.72	4	3200	7 12	9.44	20	5700			
800	1 12	1.98	4.5	3300	7 32	9.8	21	5800			
900	1 22	2.25	5	3400	7 52	10.16	22	5900			
1000	1 33	2.53	6	3500	8 12	10.53	23	6000			
1100	1 44	2.81	6.5	3600	8 32	10.9	23	6100			
1200	1 56	3.09	7	3700	8 53	11.27	24	6200			
1300	2 9	3.38	7.5	3800	9 14	11.65	25	6300			
1400	2 22	3.67	8.5	3900	9 35	12.04	25	6400			
1500	2 35	3.96	9	4000	9 57	12.43	26	6500			
1600	2 48	4.25	9.5	4100	10 19	12.83	27	6600			
1700	3 2	4.55	10	4200	10 41	13.23	28	6700			
1800	3 17	4.85	11	4300	11 3	13.64	29	6800			
1900	3 32	5.15	11	4400	11 25	14.05	29	6900			
2000	3 47	5.46	12	4500	11 48	14.46	30	7000			
2100	4 2	5.77	12	4600	12 11	14.87	31	7100			
2200	4 18	6.08	13	4700	12 34	15.28	31	7200			
2300	4 34	6.39	14	4800	12 57	15.69	32	7300			
2400	4 50	6.71	15	4900	13 21	16.1	33	7400			
2500	5 6	7.03	16	5000	13 45	16.51	34	7500			

Section XIII.

Range Tables.

Range Table for 40-pr. R.M.L. Gun of 35 cwt.

Projectile, common shell, without gas-check. Weight 38 lb. 8 oz.

Charge, 7 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.
yds.	° ' "	secs.	tenths.	yds.	° ' "	secs.	tenths.	yds.	° ' "	secs.	tenths.
100	—	—	—	2600	5 15	7.28	16.5	5100			
200	—	—	—	2700	5 31	7.59	17.0	5200			
300	0 18	0.72	1.5	2800	5 47	7.91	18.0	5300			
400	0 29	0.95	2.0	2900	6 4	8.23	19.0	5400			
500	0 40	1.19	2.5	3000	6 21	8.55	19.5	5500			
600	0 51	1.44	3.0	3100	6 38	8.88	20.0	5600			
700	1 2	1.7	3.5	3200	6 56	9.22	20.5	5700			
800	1 13	1.97	4.0	3300	7 14	9.56	21.0	5800			
900	1 24	2.25	4.5	3400	7 32	9.91	22.0	5900			
1000	1 35	2.53	5.0	3500	7 50	10.27	22.5	6000			
1100	1 47	2.81	6.0	3600	8 8	10.64	23.0	6100			
1200	1 59	3.09	6.5	3700	8 28	11.02	23.5	6200			
1300	2 11	3.38	7.0	3800	8 50	11.41	24.0	6300			
1400	2 24	3.67	7.5	3900	9 12	11.81	24.5	6400			
1500	2 37	3.96	8.5	4000	9 35	12.22	25.0	6500			
1600	2 50	4.25	9.0	4100				6600			
1700	3 3	4.54	10.0	4200				6700			
1800	3 16	4.84	10.5	4300				6800			
1900	3 29	5.14	11.0	4400				6900			
2000	3 43	5.44	12.0	4500				7000			
2100	3 57	5.74	12.5	4600				7100			
2200	4 12	6.04	13.5	4700				7200			
2300	4 27	6.35	14.5	4800				7300			
2400	4 43	6.66	15.0	4900				7400			
2500	4 59	6.97	16.0	5000				7500			

Range Tables.

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Range Table for 25-pr. R.M.L. Gun of 18 cwt.

Projectile, common and shrapnel shell, 25 lb.

Charge, 4 lb.

Mean Elevation due to each 100 yards of Range, by Interpolation.

Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.	Distance of Object.	Elev.	Time of Flight.	Lengths of Fuze.
yds.	° ' "	secs.	tenths.	yds.	° ' "	secs.	tenths.	yds.	° ' "	secs.	tenths.
100	0 8	0.23	—	2600	6 12	8.12	15.5	5100			
200	0 18	0.47	1	2700	6 53	8.50	16	5200			
300	0 28	0.71	1.5	2800	6 54	8.88	17	5300			
400	0 38	0.96	2	2900	7 17	9.26	18	5400			
500	0 49	1.22	2.5	3000	7 40	9.64	18.5	5500			
600	1 0	1.59	3	3100	8 3	10.03	19	5600			
700	1 12	1.86	3.5	3200	8 26	10.42	20	5700			
800	1 24	2.14	4	3300	8 50	10.82	20.5	5800			
900	1 36	2.42	5	3400	9 15	11.23	21	5900			
1000	1 49	2.71	5.5	3500	9 42	11.65	21.5	6000			
1100	2 3	3.00	6	3600	10 9	12.07	22	6100			
1200	2 16	3.30	7	3700	10 36	12.49	23	6200			
1300	2 30	3.61	7.5	3800	11 4	12.92	24	6300			
1400	2 45	3.92	8	3900	11 32	13.35	25	6400			
1500	3 1	4.25	8.5	4000	12 0	13.78	26	6500			
1600	3 17	4.58	9.5	4100				6600			
1700	3 33	4.91	10	4200				6700			
1800	3 49	5.25	10.5	4300				6800			
1900	4 4	5.60	11	4400				6900			
2000	4 20	5.95	11.5	4500				7000			
2100	4 37	6.30	12	4600				7100			
2200	4 55	6.65	13	4700				7200			
2300	5 13	7.01	13.5	4800				7300			
2400	5 32	7.38	14	4900				7400			
2500	5 52	7.75	15	5000				7500			

Range Table for 7-pr. R.M.L. Gun of 200 lbs. (Steel).

Projectile, double shell.

Charge, 4 oz.

Range.	Elevation.	Fuze Scale.	Range.	Elevation.	Fuze Scale.
yards.	° ' "		yards.	° ' "	
700	8 12	8.5	1400	20 48	19.5
730	8 44	9	1420	21 23	20
760	9 16	9.5	1450	21 58	20.5
800	9 48	10	1470	22 23	21
830	10 20	10.5	1500	23 10	21.5
860	10 52	11	1520	23 49	22
900	11 24	11.5	1550	24 28	22.5
930	11 56	12	1570	25 7	23
960	12 28	12.5	1600	25 48	23.5
1000	13 0	13	1620	26 33	24
1030	13 36	13.5	1650	27 18	24.5
1060	14 12	14	1670	28 3	25
1100	14 48	14.5	1700	28 50	25.5
1130	15 24	15	1720	29 33	26
1160	16 0	15.5	1740	30 16	26.5
1200	16 36	16	1760	30 59	27
1230	17 16	16.5	1780	31 42	27.5
1260	17 56	17	1800	32 46	28
1300	18 38	17.5	1820	33 6	28.5
1320	19 10	18	1840	33 46	29
1350	19 42	18.5	1860	34 26	29.5
1370	20 14	19	1880	35 6	30

Packing of Siege Carriages.

Section XIV.

Section XIV.—Packing of Siege Carriages.

The R.M.L. 64-pr., 40-pr., and 25-pr. siege carriages are arranged for use as (1) ordinary siege carriages, and (2) as "overbank" carriages for high parapets, by the addition of a top carriage.

They are issued as low or ordinary siege carriages, and are accompanied by cases containing the loose fittings, and also the top carriage and fittings necessary for adapting them for overbank fire.

The top carriage, with its gear, gun-fittings, jointed rammer, wire rope, sponge, &c., and the fittings and leather straps that are common to it, either as a "low" or an "overbank" carriage are packed in a large case; the knock up wrench, spanner and breech bar being strapped in position on the top carriage.

In the large case is also carried a small case containing the special fittings for gun and carriage when used in the ordinary manner.

The 64-pr. case, in addition to the other stores, carries two check chains and the wire loop for attaching them to the trail eye.

On the lid of each case a list of its contents is fixed, also instructions to guide the attachment of the fittings.

Each case is marked with the Nos. of the gun and carriage to which the fittings belong.

8-INCH AND 6.3-INCH HOWITZER BEDS AND PLATFORMS.

Each bed is issued with a case containing the elevating and compressor gear, and the bolts, small fittings, and fork wrench belonging to the platform.

On the lid of the case a list of its contents is fixed, also directions for the attachment of the fittings and for mounting the bed and howitzer on the platform.

Each case is marked with the No. of the bed to which the fittings belong.

The parts of each platform are lashed together in three parcels, consisting respectively of the two side baulks, the two centre baulks and the two transoms.

64-PR. CARRIAGE.

GENERAL DIRECTIONS TO PREPARE THE CARRIAGE AS AN ORDINARY SIEGE TRAVELLING CARRIAGE.

1. *Fixing the worm-shaft.*—Remove the fixing bolts from the two caps of the bearings of the elevating worm, open the cap of

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Packing of Siege Carriages.

the worm-wheel and put in the special worm-shaft (from small case), with hand wheel from large case. Secure the worm shaft by these caps and bolts.

2. *Mounting the gun.*—Take out the four preserving screws on right side of the gun and secure pivot piece by its fixing screws.

Take out split pin and unscrew steel pivot out of metal plate, mount the gun and depress it.

3. *Fitting in elevating arc, &c.*—Put in elevating arc, gearing it between the friction roller and pinion, taking care that the hole for the pivot in the arc is nearly at the top. Secure the arc to the gun by screwing the pivot through the elevating arc into the metal plate on gun and replace the pin.

Capsquares.—Put on the capsquares, securing them by keys.

Coins, scotch, &c.—Place the stool-bed, fix the shifting roller in its place under front of carriage, also coins and scotch between the brackets by the proper straps.

Spare bolts.—Fix four spare bolts, two respectively in front of right and left brackets.

GENERAL DIRECTIONS FOR PREPARING THE CARRIAGE FOR OVERBANK FIRE.

1. *Fixing front plate.*—Fix the hand-wheel to the worm-shaft. Remove the eight fixing bolts from front elevating plate, and then attach this plate to the brackets and front transom by these bolts and nuts.

2. *Preparing the top carriage.*—Remove the rear clips, clip-plates, and bolts in the bottom flange of top carriage, also the large leather securing strap from the front of the low carriage, and fix the latter on the top carriage. Loosen the large nuts of the trunnion stay, allowing the four front securing bolts to swing on it when the top carriage is raised.

3. *Fixing the top carriage.*—Raise the top carriage into position on the low carriage, taking care that the two inner securing bolts pass through the front plate without injury to their threads. Place the staple plate for side-arms on the left side of the top-carriage, on to the outside holding down bolt, and then secure the top carriage by the clips, rear clip-plates and bolts previously removed. Screw up the nuts of the trunnion stay.

4. *Fixing the laying step.*—Hook the laying step on the rear transom of the low carriage, allowing the rear to rest on the plate for hanging scale.

OPERATIONS IN MOUNTING THE GUN.

1. *Fixing elevating patches on the gun.*—Clear out the holes in underside of the gun and attach the gunmetal plates to it by the screws supplied and remove the wrought-iron bolts.

2. *Placing shifting roller.*—Place the shifting roller into the lower step of the rack inside the brackets of top carriage and remove the capsquares.

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3. *Mounting the gun.*—The gun is now to be mounted, breech resting on the shifting roller.

4. *Fixing elevating arc.*—The elevating arc is passed through from the front, geared into the elevating pinion, and secured by passing the wrought-iron bolts through the plate and elevating arc, and key-up, taking care to secure the key with the keep leather to the two patches. Place and secure the capsquares.

5. *Roller withdrawn.*—The roller is now withdrawn by depressing the gun.

NOTES.—1. *Stamped Numerals show adjacent parts.*—In fixing the parts together care must be taken that they are placed in accordance with numerals stamped to show the parts that should be adjacent to each other.

2. When the stores are removed from the large case the spanners and knock-up wrench are carried on the carriage, and the wrench for elevating plates in the small case.

40-PR. CARRIAGE.

GENERAL DIRECTIONS TO PREPARE THE CARRIAGE AS AN ORDINARY SIEGE TRAVELLING CARRIAGE.

1. *Fixing the worm-shaft.*—Remove the fixing bolts from the two caps of the bearings of the elevating worm; open the cap of the worm-wheel and put in the worm-shaft, with hand wheel attached (from large case). Secure the worm-shaft by these caps and bolts.

2. *Mounting the gun.*—Take out the four preserving screws on right side of the gun and secure pivot piece by its fixing screw. Take out split pin and unscrew steel pivot out of metal plate; mount the gun and depress it.

3. *Fitting in elevating arc, &c.*—Put in elevating arc, gearing it between the friction roller and pinion, taking care that the hole for the pivot in the arc is nearly at the top. Secure the arc to the gun by screwing the pivot through the elevating arc into the metal plate on gun and replace the pin.

Capsquares.—Put on the capsquares, securing them by keys; place the stool bed in its place.

Shifting roller, &c.—Fix the shifting roller in its place under front of carriage, also coils and scotch between the brackets, by the proper straps.

Spare bolts.—Fix eight spare bolts into vacant holes, three respectively in front of right and left brackets, and two in front transom; two in front of right bracket also hold the drag-shoe hook.

GENERAL DIRECTIONS TO PREPARE THE CARRIAGE FOR OVERBANK FIRE.

1. *Fixing the worm-shaft.*—Fix the worm-shaft and hand wheel on to the front elevating plate (the hand wheel towards the (A. M.)

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Packing of Siege Carriages.

rounded edge of the plate), removing the front bearing and its cap, then, inserting the worm-shaft in its place, secure the bearing and replace the cap.

2. *Fixing front plate.*—Remove the eight fixing bolts from front plate, and fix this plate, with elevating gear attached, to the brackets and front transom by the above named bolts and nuts, at the same time fixing the front hook for drag-shoe inside the right bracket. Remove the rear-clips, clip-plates, and bolts in bottom flange of top carriage, also the front staples, with large leather securing strap from the front of the low carriage, and fix them with the same screws on the top carriage. Loosen the large nuts of the trunnion stays, allowing the four front securing bolts to swing on it when the top carriage is raised.

3. *Placing the top carriage.*—Raise the top carriage into position on the low carriage, taking care that the two inner securing bolts pass through the front plates without injury to their threads. Place the staple plate for side-arms on the left side of the top carriage, on to the outside holding down bolt, and then secure the top carriage by the rear clips, clip-plates and bolts previously removed. Screw up nuts of the trunnion stay.

4. *Fixing the laying step.*—Fix the laying step to the supporting plate for the coin (already in the low carriage) by the stud and key underneath.

OPERATIONS IN MOUNTING THE GUN.

1. *Attachment of patches.*—Clear out holes in underside of the gun and attach the gunmetal plates to it by the screws supplied, and remove the wrought-iron bolts. Place the shifting roller into the hooks on brackets of top carriage, and remove the capsquares.

2. *Mounting gun.*—The gun is now mounted, the breech resting on the shifting roller.

3. *Elevating arc, &c.*—The elevating arc is passed through from the front, geared into the elevating pinion, and secured by passing the wrought-iron bolts through the plate and elevating arc, and key-up, taking care to secure the key with the keep leather to the two patches. Place and secure the capsquares; the roller is now withdrawn by depressing the gun.

NOTES.—1. *Numerals indicate adjacent parts.*—In fixing the parts care must be taken that they are placed together in accordance with numerals stamped to show the parts that should be adjacent to each other.

2. When the stores are removed from the large case the spanners and knock-up wrench are carried on the carriage, and the wrench for elevating plates in the small case.

25-PR. CARRIAGE.

GENERAL DIRECTIONS TO PREPARE THE CARRIAGE AS AN ORDINARY SIEGE TRAVELLING CARRIAGE.

1. *Fixing the worm-shaft.*—Remove the fixing bolts from the two caps of the bearings of the elevating worm, open the cap of

Packing of Siege Carriages.

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the worm-wheel and put in the worm-shaft with hand wheel attached (from large case). Secure the worm shaft by these caps and bolts.

2. *Mounting the gun.*—Take out two preserving screws and clear out the third hole on right side of the gun, and secure pivot piece by its fixing screws. Take out split-pin and unscrew steel pivot out of metal plate, mount the gun and depress it.

3. *Fitting in elevating arc.*—Put in elevating arc, gearing it between the friction roller and pinion, taking care that the hole for the pivot in the arc is nearly at the top; secure the arc to the gun by screwing the pivot through the elevating arc into the metal plate on gun, and replace the pin.

Capsquares.—Put on the capsquares, securing them by keys. Place the stool bed in its place, also coins and scotch between the brackets by the proper straps.

4. *Spare bolts.*—Fix four spare bolts into vacant holes, two respectively in front of right and left brackets.

GENERAL DIRECTIONS TO PREPARE THE CARRIAGE FOR
OVERBANK FIRE.

1. *Fixing the worm-shaft.*—Fix the worm-shaft and hand wheel on to the front elevating plate (the hand wheel towards the rounded edge of the plate), remove the front bearing and its cap, then, inserting the worm-shaft in its place, secure the bearing and replace the cap.

2. *Fixing front plate.*—Remove the four fixing bolts from front plate, and then fix this plate, with elevating gear attached, to the brackets by these bolts and nuts.

3. *Preparing the top carriage.*—Remove the rear clips, clip-plates, and bolts in the bottom flange of the top carriage. Take out the two securing straps and secure them—the 5-foot muzzle strap in front, and the 7-foot breech strap in rear—on one side of the bracket in their proper staples.

NOTE.—The 5-foot strap is for securing round the chase of the gun, and the 7-foot strap round the breech, when the gun is carried in the travelling position for overbank use.

Loosen the large nuts of the trunnion stay, allowing the four front securing bolts to swing on it when the top carriage is raised.

4. *Fixing the top carriage.*—Raise the top carriage into position on the low carriage, taking care that the two inner securing bolts pass through the front plate without injury to their threads. Secure the top carriage by the rear clips, clip-plates, and bolts previously removed. Screw up the nuts of the trunnion stay.

5. *Placing laying step.*—Remove the four bolts with nuts in trail of low carriage, and secure the laying step in its place with them.

6. *Fixing the staple for McMahon's spanner.*—Loosen the bolts and turn down the staple for McMahon's spanner on rear of the top carriage, and secure the staple by the bolt already in position in the low carriage.

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OPERATIONS IN MOUNTING THE GUN.

1. *Attachment of patches on gun.*—Clear out holes in underside of gun and attach the gunmetal plates to it by the screws supplied, and remove the wrought-iron bolts.

2. *Placing shifting roller.*—Place the shifting roller into the hooks on brackets of top carriage. Remove the capsquares.

3. *Mounting gun.*—The gun is now to be mounted, breech resting on the shifting roller.

4. *Fixing elevating arc.*—The elevating arc is passed through from the front, geared into the elevating pinion, and secured by passing the wrought-iron bolts through the plate and elevating arc, and key-up, taking care to secure the key with the keep leather to the two patches. Place and secure the capsquares.

5. *Withdrawal of roller.*—Now withdraw roller by depressing the gun.

NOTE.—*Numerals show parts that should be adjacent to each other.*—In fixing the various parts care must be taken that they are placed together in accordance with numerals stamped so as to indicate the parts that should be adjacent to each other.

It will be necessary to remove one of the fixing bolts of the right bearing of the pinion and spindle before all the bolts securing the front plate can be placed.

The left clip-plate must be held above the bracket for wad-hook worm on the breast, while the top carriage is being lowered into its place.

When the stores are removed from the large case, the spanner and knock-up wrench are carried on the carriage, and the wrench for elevating plates in the small case.

8-INCH AND 6.3-INCH HOWITZERS, MOUNTED ON BEDS.

GENERAL DIRECTIONS TO PREPARE THE BED.

Lift the bed on to the platform, and place it on blocks to clear the rollers.

1. *Placing the rollers.*—Take out the split keys inside and remove the six roller axles, take out the wooden preserving blocks, put in the rollers, replace axles and keys.

Take off the 4 compressor bars, and run in the guide bar from the rear.

Metal flap.—Put in the metal flap, securing it by the pin. Drop the metal flap over the pivot in ground platform.

Remove the blocks and lower the bed on to its rollers.

Remove the securing plates from the bottom plate.

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Guide bar and compressor plates.—Push the guide bar on one side and insert three compressor plates thus, on each side:—

- 1st, the plate with the hook nearest the bar;
- 2nd, the thin plate next;
- 3rd, the thick plate outside.

Securing plates.—Fix the securing plates on the top of the bottom plate by the four screws previously removed.

Compressor bars.—Push up from the rear the compressor bars, two on each side, between the three plates, replace the indiarubber rings between each, securing the bars by pins, collars and split keys.

Cramp.—Place the compressor cramp inside the bed, across the plates, with bevelled side towards the rear. Place the compressor screws through holes in brackets, and screw them through the cramp.

Levers, compressing and adjusting.—The compressing lever is now fixed on to the compressor screw in left bracket, and the adjusting lever to adjusting screw on right bracket.

Guide plate.—Refix the guide plates on the rear transom.

Elevating gear.—Insert the pinion spindle from the inside of the brackets, having previously removed the nuts and collar. Put on the two metal brackets for worm-spindle, removing the caps; next put on the worm-wheel, with friction cone, and worm-spindle in the metal brackets, at the same time replace the two caps and secure them.

Put on the hand wheel, and secure with collar and nut. Put on the guard, securing it with three fixing screws.

Friction cone.—Secure and adjust the friction cone with collar and two nuts, so that a slight slip is allowed for each round. Screw in the lubricating tube.

Remove the capsquares, and mount the howitzer, and depress.

Elevating arc.—Remove split pin and unscrew steel pivot from metal plate on gun, put it in the elevating arc, gearing it between the friction roller and elevating pinion, and attach to gun by screwing the pivot through the elevating arc into the metal plate on gun and replace the pin.

NOTE.—Adjustment of compressor.—Run the bed back about 3 feet from front stop, adjust the compressor by means of the adjusting screw and lever till one man, by exerting his whole power on the compressing lever, can just force it past the catch.

GENERAL DIRECTIONS TO PUT TOGETHER THE PLATFORM.

1. *Fixing pivot.*—Put in the pivot, with metal plate, into the front transom, drop in the four bolts, place underneath the spindle pivot plate, and secure by the five keys.

2. *Placing the transoms, strengthening plate, and baulks.*—Place the transoms with bolts in position, and the bottom strengthening

Section XIV.

Packing of Siege Carriages.

plate with widest part of flanges towards the rear between them in the middle; then place one outside baulk, and next the others in succession. Tighten up the nuts with the forked wrench.

Strengthening plate.—Secure the strengthening plate by the two screw bolts in sides of outer baulks.

INSTRUCTIONS TO BE OBSERVED IN FIXING AND REMOVING
PIVOT PIECES OF GUNS FOR MOUNTING ON OVERBANK
CARRIAGES.

1.—Remove the preserving screws from the screw holes* by means of the wrench provided with the fittings, wipe and thoroughly clean the seatings on the gun for the elevating plates.

2.—Carefully examine the plates and see that they are marked with the correct number of the gun. This number will be found on the inside of the plates.

3.—Clean thoroughly the back of the plates, so that no grit or dirt may interfere with their bedding properly, and try them in place. It will be observed that the front plate is marked "F," and the hind plate "H." The heads of the steel bolts for securing the elevating arc to the plate are at the left side of the plates, looking from breech to muzzle.

4.—Insert the fixing screws and screw them securely home with the wrench above mentioned.

5.—Before attaching the elevating rack to the pivot pieces, it will be necessary to remove each of the steel bolts from the pivot pieces. To do this remove the keep-pin by pressing back the spring, when the bolt can be readily removed. When the rack is in position insert the bolt, taking care that the key under the head is opposite the keyway in lug of plate, then drive the bolts home, place the washer in position, and drive in the keep-pin.

6.—In removing the plates, all that is necessary is to take out the fixing screws, the plates can then be lifted off, and the preserving screws should at once be screwed into the holes.

NOTE.—If a spring keep-pin be used, it must be removed by applying a piece of hard wood to the point, striking with the hand hammer. This will free the bolt from the washer, as well as from the lugs of the plate.

USE OF GUNCOTTON FOR THE DESTRUCTION OF
GUNS.

THE HASTY DISABLEMENT OF SIEGE GUNS TEMPORARILY
CAPTURED.

This duty will be performed by the Royal Artillery, the necessary supplies of guncotton and detonators being obtained from the Royal Engineer Field Park.

* These should be preserved, they are interchangeable.

Destruction of Guns.

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The following stores will be carried with each unit of the Siege Train :

- (a) Two cartouches, each capable of holding eight half slabs (1 lb. each) of dry guncotton.
- (b) Two cylindrical leather cases, each containing a tin cylinder holding eight detonators with Bickford fuze attached.
- (c) Two leather pouches, containing a vesuvian match-box and a small reel of twine.

The operation of disabling the captured guns will be performed by a party of the Royal Artillery (corresponding to a "spiking" party), who will be furnished with the necessary stores.

In the case of guns of 64-pr. calibre and upwards, place two 1-lb. slabs of guncotton lengthwise on the chase, about 1 foot from the muzzle, tying it on with twine to secure it from disturbance by wind or other accidental cause. Insert a No. 8 detonator, with length of Bickford fuze attached, in the hole in the slab. The tail of the Bickford fuze should point to leeward, to lessen the chance of a spark igniting the guncotton before the detonator acts.

It now only remains to light the Bickford fuze with the matches provided for the purpose, and to retire to a safe distance, about 50 yards, and await the result of the explosion. The 2-feet length of Bickford fuze burns about 40 to 50 seconds, giving ample time to the operator to retire to a position of safety.

Should a projectile proper to the gun be available, it is desirable to see whether the bore has been so dented as to prevent loading; and if it has not, to repeat the operation, using two 1-lb. slabs tied on to the same spot, each slab in contact with the metal, and their long sides touching each other.

Should circumstances permit, the effect of the detonation will be increased by placing a filled sand bag or a sod of turf on the guncotton when lashed in position on the chase. This should be done before inserting the detonator, which should not be withdrawn from the tin cylinder in which it is carried until everything is ready for its insertion and ignition.

Caution.—No force is ever to be used in inserting the detonator. Its effect will be secured by its insertion as far as it will go without the use of force.

In order to ensure detonation, it is desirable that the guncotton should be perfectly dry; therefore, if it is necessary to use it while heavy rain is falling, some ready envelope should be employed for wrapping the slab in.

PART IV.—GENERAL DESCRIPTION OF AND DRILLS WITH ORDNANCE FOR GARRISON SERVICE.

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GENERAL INSTRUCTIONS.

1. The officer in command of a work is responsible for everything connected with it. He should have suitable look-out stations within the work for himself and staff, so as to have an uninterrupted view.

2. Coast batteries should be provided with out-stations to assist in obtaining the range and direction of objects to be engaged; the commanding officer of each battery should be in telegraphic communication with such stations; he should also be in immediate communication with each battery or gun floor in double tier works, so that the range and deflection may be signalled.

3. The most perfect understanding should exist between him, the look-out parties, and Nos. 1, as to the signals that are to be used in signalling the approach of an enemy, the object to be fired at, or result of the fire.

4. On sea fronts, the shoals, channels, and passages for vessels drawing certain depths of water, should be well known; and on land fronts the character of the country, its woods, hollows, ravines, marshes, fences, roads, and hills; for upon this depends very much the value of artillery fire.

5. Tables (see §2847, Changes in War Stores) showing the bearings and measured distances to certain fixed objects should be conspicuously placed in each battery.

6. In a system of works supplementing each other, their efficiency will depend very much on the arrangements made for placing them in telegraphic communication with each other, and with the torpedo system of defence.

7. The officer in command should ascertain that every individual under his command not only understands the several duties he has to perform, but also all the appliances at his disposal for carrying out these duties; this must be particularly attended to in double tier batteries, where the lifts will often have to serve one, or even two guns in each tier.

General Instructions.

8. In all new works the guns are numbered from right to left (when facing the direction the guns are pointing); the several ammunition stores and lifts are lettered so as to show the guns they are intended to serve; speaking tubes are also provided at the several lifts, and are lettered according to the guns or batteries for which they are intended.

9. Circumstances alone can determine the rate of firing. Against ships in motion, or in the defence of a channel attempted to be forced by steamships, it cannot be too rapid, provided the gun is carefully laid.

STORES AND FITTINGS.

10. All parts of the guns, carriages, and platforms should be most carefully examined, to see that the sights are correct, the elevating and traversing gear oiled, the racers well swept, and the trucks running true, the hydraulic buffers filled with the proper amount of oil, or the compressors properly adjusted and in working order; that the rope mantlets work easily, the buckets are supplied with water, the hoisting gear at the cartridge and shell lifts in working order, the lamps in the ammunition stores and their passages burning properly, and a supply of spare stores, such as side arms, &c., is at hand.

11. The test for ascertaining that the cylinder of the hydraulic buffer contains the proper amount of oil, is to measure the depth of oil at the filling hole when the gun is run up to the stops; the depth should be $4\frac{1}{8}$ inch for all guns except the 12.5 inch of 38 tons, for which the measure of oil at the filling hole should be 3.125 inch or 3 inch, according to whether the platform is constructed to allow of 6 feet or 7 feet recoil.

12. The Elswick compressor is in adjustment, when the adjusting lever on the left side of the carriage being at about the third hole from the top of the arc, the compressor lever on the right side of the carriage can just be forced down by one man beyond the catch on its arc, the rocking levers being similarly inclined against the plates. With platforms fitted with a tripper the compressor becomes self-acting.

13. In casemated batteries the stores belonging to each gun should be kept on the gun and carriage.

14. In open or exposed batteries the stores and tackle are kept in places appropriated for the purpose as close to the guns as possible, all the moveable stores being taken off the gun and carriage.

AMMUNITION.

15. Careful men must be selected for the ammunition stores, who before entering them, must change their own clothes and put on magazine clothing and shoes, in compliance with the orders on that head.

16. The orders respecting lampmen must be strictly adhered to.

General Instructions.

17. No laboratory operations of any kind are to be carried on in any ammunition store, but only in the places specially provided.

18. Fuze and tube cylinders are not to be opened in any shell store. Cartridges for R.M.L. guns, from 7 inch upwards, are stored in zinc cylinders stamped with the weight of charge and nature of gun for which intended.

19. The projectiles for immediate service should be brushed, gauged, and all burrs removed from the studs. Palliser projectiles will generally be in the battery close to the gun. Should there be any chance of delay in the service of other shells (as, for instance, in a double tier battery), a supply of them also should be provided in the battery as much under cover as possible, the remainder being in the shell store. In fixing the clip for raising a projectile up the lift, the screw is to be tightened up before hoisting. Shells are to be fuzed near the guns and as much under cover as possible. Projectiles 7-inch and upwards, with gas cheeks attached, are stacked with their bases resting on two pieces of wood 9" x 1" square.

With R.M.L. guns common shells with lanyard are used for drill purposes. With B.L. the projectile must pass easily through the bore.

DRILL AND PRACTICE.

20. When a battery is to be manned or guns used for drill, the detachments can be told off on parade, numbered for their respective guns, and marched direct to where the gun stores are kept. Having obtained the stores they will be marched to the battery. In action or at practice No. 1 after preparing for action should satisfy himself that every number is acquainted with his duties before reporting his gun ready for action.

21. Previous to practice from a casemated battery, the window sashes in the battery itself or in buildings immediately adjacent should be placed in a horizontal position or otherwise opened, and whenever a gun is being worked in a casemate for drill or other purposes, the entire bulkhead (both boarding and framework) should be removed. When actual practice is being carried on the boarding of the bulkheads in at least three adjacent casemates on each side should be removed.

22. In loading the cartridge cylinder should be kept closed until the sponge is out of the bore, then no time is to be lost in introducing the cartridge.

23. It is an essential duty of the No. 1 to ascertain that the charge is rammed home. This can be easily discovered if the rammer is marked. The present service mark is a brass screw, which shows when the full charge and common shell are home.

24. Wedge wads are to be used when firing from R.M.L. guns mounted on sliding or Moncrieff carriages, but not at drill.

If at practice wedge wads are not used, the gun should have

Nomenclature of Artillery Magazines, Stores, &c.

an elevation of at least 4° before "running up," which should also be done carefully to prevent the shell "starting."

25. A shot that is jammed and cannot be withdrawn with the extractor must be blown out, the charge having been previously drowned, and a few grains of powder poured by hand into the vent.

26. After firing the bore should be washed out. The tampeon is not to be replaced until the bore is dry.

EXPLANATION OF TERMS.

27. The term "Load" in the detail of general duties means the service of cartridge, projectile, and wedge wad.

28. "Side arms" means sponge, rammer, wad hook, and shell-extractor.

29. "Attending to vent" means drifting and placing the vent server in the vent.

30. At the word "under cover" at any time during drill or practice the whole of the numbers at the gun will lay down their stores and double under cover.

31. At the word "*Stand fast*" the Nos. will remain steady in the position they are then in, until "*go on*" is given.

The Drill is based upon the appliances available, and fitments of carriages and platforms of the latest patterns. At stations where such are not met with, or are associated with others of an earlier pattern, it may be found necessary to modify to a certain extent the details laid down, but the general principle should, as far as possible, be adhered to.

Full reference on all guns and their stores is given in "Index to the Instructions given to various patterns of Rifled Ordnance, Ammunition, and other Stores."—*War Office, April, 1877.*

For full detail of stores issued for the Service of Guns *vide* Equipment Regulations.

NOMENCLATURE OF ARTILLERY MAGAZINES, STORES, &c.

"*Magazine.*"—Building or buildings with passages leading thereto, in which powder in bulk, filled cartridges, or shells are stored.

"*Main Magazine.*"—The principal magazine in a work or battery in which there is more than one magazine.

"*Shifting Room*" or "*Shifting Lobby.*"—The chamber or portion of the entrance passage to be devoted to putting on or taking off magazine or laboratory clothing.

"*Magazine Entrance.*"—The entrance provided with a shifting room, through which those going to the magazines must pass. Where there is more than one they must be distinguished by

Nomenclature of Artillery Magazines, Stores, &c.

their positions, thus,—“North Magazine Entrance;” “West Magazine Entrance.”

“*Ammunition Entrance.*”—The entrance to the magazine for ammunition only.

“*Magazine Store.*”—A chamber within a magazine (if provided) in which the hides, wadmiltits, and spare magazine clothing may be kept.

“*Cartridge Store.*”—A chamber in which filled cartridges are stored.

“*Shell Store.*”—A chamber in which filled shell are stored.

“*Expense Cartridge Store.*”—A cartridge store appropriated for the service of particular guns, and from which the service of a gun or guns is conducted.

“*Expense Shell Store.*”—A shell store appropriated for the service of particular guns, and from which the service of a gun or guns is conducted.

“*Powder Passage.*”—A passage along which powder (in cartridges or in bulk) is transported.

“*Shell Passage.*”—A passage along which shells are transported.

“*Ammunition Passage.*”—A passage along which both natures of ammunition are transported.

“*Lighting Passage.*”—A passage by which access is gained to the lamp recesses.

“*Cartridge Serving Room.*”—A chamber on the same level as the gun into which the cartridge lifts lead, and from which the service of cartridges is conducted.

“*Shell Serving Room.*”—A chamber on the same level as the gun into which the shell lifts lead, and from which the service of shells is conducted.

“*Cartridge Recess.*”—A small receptacle for the storage of a few cartridges for the immediate service of a gun.

“*Shell Recess.*”—A small receptacle for the storage of a few shell for the immediate service of a gun.

“*Cartridge Issuer.*”—A hatch in a door, or opening in a wall, through which cartridges are passed.

“*Shell Issuer.*”—A hatch or opening in a wall through which shells are passed.

“*Cartridge Lift.*”—The lift up which cartridges are hoisted.

“*Shell Lift.*”—The lift up which shell are hoisted.

Nomenclature of Artillery Magazines, Stores, &c.

"General Lift."—A larger description of lift, through which powder in bulk may be passed.

"Artillery General Store."—A store for the reception of the spare gun stores of all natures.

"Artillery Store for Small Stores."—A store in a battery for the reception of the sights, elevating arcs, and other small stores belonging to the guns and required for their immediate service.

"Store for Side-Arms and Tackle."—A store for the reception of the larger stores necessary for the service of the guns.

"Laboratory."—A building or buildings with passages leading thereto in which ammunition is examined, cartridges made up, and shells filled.

"Cartridge or Shell Filling Room."—A chamber in the laboratory in which cartridges are made up, and shells filled.

"Receiving Hatch."—An opening in the door or wall of a cartridge or shell-filling room, through which empty shell or powder in bulk is passed.

"Lamp Store."—A chamber or place in a fort or battery allotted for the storage of lamps and for the use of the lampman.

"Store for Field Forge, Fitting Tools, &c."—A chamber allotted for the storage of articles required for effecting trifling repairs to the armament.

ORDNANCE FOR GARRISON SERVICE.

GENERAL DUTIES.

No. at the Gun.	S.B. Gun† and 64-pr. R.M.L. on Garrison Standing Carriage, 9 Numbers.	40-pr. and 64-pr. R.M.L. and 40-pr. R.B.L. Gun on Travelling Siege Carriage, 9 Numbers.	64-pr. and 80-pr. R.M.L. and 7" R.B.L. Gun on Traversing Platform, 9 Numbers.	7" on Moncrieff Carriage and Platform, 10 Numbers.	7" and 9" on Traversing Platform, 10 Numbers.	10", 11", and 12" on Casemate Platform, 15 Numbers.	12-5" on Traversing Platform, 17 Numbers.
1.	Commands, directs or superintends boring and fixing fuzes, directs the gun into the line of fire in run- ning up, and lays.	Commands, directs or superintends boring and fixing fuzes, holds on to preventor rope, and lays.	Commands, directs or superintends boring and fixing fuzes, runs up, and lays.	Commands, directs or superintends boring and fixing fuzes, runs up, and lays.	Commands, directs or superintends boring and fixing fuzes, and lays.	Commands, directs or superintends boring and fixing fuzes, assists to raise projectiles (if re- quired), and lays.	Commands, directs or superintends boring and fixing fuzes, assists (if required) to raise projectile, at- tends to valve lever of running-up jack, and lays; attends to indicator.
2.	Searches, sponges, runs home, runs up, and traverses.	Searches, * sponges, runs home, runs up, and traverses.	Searches, sponges, runs home, runs up, ele- vates, and traverses.	Searches, places projectile in bore, runs home (attends to lever if re- quired), and elevates.	Searches, sponges, runs home, runs up, and elevates (with 9" steadies projectile and attends to mantlet).	Searches, sponges, steadies and guides projectile in raising, runs home, runs up, and elevates.	Searches, sponges, assists 3 with cart- ridge and projectile, runs home, assists 12 to attend to mantlet, and elevates.
3.	Loads, uncaps or re- moves safety pin from fuze when in the bore, runs home, runs up, and traverses.	Loads, uncaps or re- moves safety pin from fuze when in the bore, runs home, runs up, and traverses.	Loads, uncaps or re- moves safety pin from fuze when in the bore, runs home, runs up, elevates, and traverses.	Sponges, loads, uncaps fuze when in the bore, runs home (attends to lever if required).	Sponges, loads, uncaps fuze when in the bore, runs home, runs up, and elevates (with 9" steadies projectile, and attends to mantlet).	Searches, sponges, loads, hooks and unhooks hoist- ing tackle, steadies and guides projectile in rais- ing, uncaps fuze when in bore, attends to port bar, runs home, runs up, and elevates.	Searches, sponges, loads, hooks and un- hooks hoisting tackle, steadies and guides projectiles in raising, projectiles in raising, uncaps fuze when in bore, attends to port bar, runs home, pumps the running up jack, and assists 11 to attend to mantlet.
4.	Attends to side arms, and supplies them to 2, runs up, attends to elevating screw, and coin in laying.	Attends to side arms, and supplies them to 2, runs up, and ele- vates.	Attends to side arms, and supplies them to 2, runs up, attends to eleva- ting screw, and coin in laying, and compressor.	Attends to side arms, and supplies them to 2, traverses (if re- quired).	Attends to side arms, and supplies them to 2, and traverses.	Attends to side arms and supplies them to 2, runs home, and traverses.	Attends to side arms and supplies them to 2, runs home, and traverses.
5.	Attends to vent, runs up, makes ready, and fires.	Attends to vent, runs up, makes ready, and fires.	Attends to vent, sup- plies wedge wads, runs up, holds on to pre- ventor rope, makes ready, and fires.	Attends to vent, de- presses the gun, for loading, supplies wedge wads, elevates about 1° before run- ning up, traverses and (attends to lever, if required) makes ready, and fires.	Attends to vent, sup- plies wedge wads, sup- plies traverses, with 9" steadies projectile, makes ready, and fires.	Supplies wedge wads, raises projectile, attends to snatch block, runs home, and traverses.	Supplies wedge wads, raises projectile, runs home, attends to snatch block, tra- verses, and attends to lever of chain nipping gear.

R.M.L. Ordnance, 64-pr. to 12·5 INCH.

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R.M.L. Ordnance (64-pr.).

Section I.

64-PR. R.M.L. CONVERTED GUN.

DESCRIPTION.

		58-cwt. guns.	71-cwt. guns.
Length	{ nominal ..	9 ft. 6 in. ..	9 ft.
	{ of bore ..	9 ft. 0·45 in. . .	8 ft. 7·27 in.
	{ of rifling ..	8 ft. 5·45 in. . .	8 ft. 0·27 in.
Preponderance	..	6 cwt. ..	6·375 cwt.
Calibre. . .	..	6·29 in. ..	6·29 in.
Nominal weight	..	58 cwt. ..	71 cwt.
Grooves	..	3 ..	3
Twist of rifling, uniform		1 in 40 calibres	1 in 40.

PATTERNS.

Two patterns of this gun, converted on the Palliser principle, are met with for land service, mounted on garrison standing carriages or on sliding carriages and traversing platforms, viz.:—

64-pr. of 71 cwt., converted from 8 in. S.B. of 65 cwt.

64-pr. of 58 cwt. „ „ 32-pr. S.B. of 58 cwt.

These guns are examined after every 150 rounds.

MODE OF CONVERSION.

The mode of conversion consists in boring out the old gun and making a wrought-iron tube to fit the casing thus prepared; this tube is slightly smaller than the bore of the casing. When fitted into its place it is secured there by means of a cast-iron collar, screwed into the muzzle end of the casing, over a shoulder on the end of the tube; a wrought-iron plug is also screwed through the casing underneath the chase and into the barrel, preventing any chance of the latter shifting round.

RIFLING.

The rifling is termed “the plain groove system,” being really the narrow deep portion of the shunt system of rifling, now obsolete, the ammunition employed with the shunt rifled pieces, as also with the 64-pr. W.I. gun, is, therefore, applicable to the converted 64-pr. The bottom of the groove is concentric with the bottom of the bore; it is ·73 inch wide at the top, ·6 inch at the bottom.

VENTING.

In the 71 cwt. gun the old vent patch is removed and the old vent closed with a wrought-iron screw plug, a new vent being drilled a little from the breech end; it is bushed with a “through” vent. The 58-cwt. gun is vented in the original position.

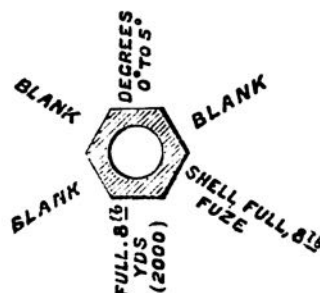
(A. M.)

N

SIGHTING.

The 58-cwt. gun is provided with centre sights only, viz. :—

One centre hind sight. This is a short scale for use up to 2,000 yards or 5° . It works in a gun-metal socket fixed in the gun, and is provided with a set screw; is six-sided, and marked as follows :—

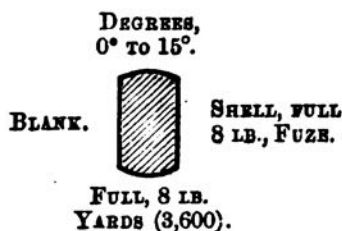


Marks III. or V. centre hind sights can be issued with this gun. The 64-pr. 58-cwt. of future issue will be provided with new pattern sights, the centre hind sight (Mark VI. §3,205) has a deflection leaf and a longer hexagonal bar than the foregoing, being graduated in degrees (up to 12°) on the front face, and in yards (to 4,000) on the rear face with a fuze scale on the right-rear face. The muzzle sight is recessed into the dispart patch on the muzzle.

One centre foresight. Consists of a pillar, collar, and socket of gun-metal, a steel leaf, and screw for fixing the leaf. The socket is permanently fixed in a bracket attached to the gun; the pillar and collar each lock into it with a bayonet joint—so that when once the sight is in its true position it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle.

The 71-cwt. gun is provided with side sights only, viz. :—

The tangent scales (one on each side) graduated up to 15° , and marked as follows:



Marks II. (iv.) III. (iv.) or IV. tangent sights with deepened notch can be issued with this gun.

Two trunnion sights (one on each side), similar to the centre foresight of the 58-cwt. gun, fitting into gun-metal brackets attached to the gun over the trunnions by two screws.

R.M.L. Ordnance (64-pr.).

Section I.

PROJECTILES.				Weight, lbs. ozs.
Shells	Common*	..	{ empty	56 14
		..	{ filled, with 7 lbs. 2 oz. bursting charge ..	64 0
		..	{ filled, with 234 mixed metal bullets, 14 per lb., and 9-oz. bursting charge	66 9
	Shrapnel ..	..	..	66 9
Shot	{ case, filled with 50 8-oz. sand shot, clay and sand			49 14½
	{ Spherical (for practice only)			32 0

Gas check, weight of.

Common shell is used on land fronts against earthworks, buildings, &c.; on sea fronts against shipping.

Shrapnel shell is used when the range is beyond the effective power of case shot; on land fronts against bodies of troops, on sea fronts against boats.

Case shot is used for close quarters against troops or boats. Two can be used on emergencies at close quarters.

CHARGES.

Full or service 8 lbs. L.G. or R.L.G. powder.

FUZES.

Percussion	{ Pettman, G.S. R.L., Mark II. }	for use with common shell	{ sea fronts. land fronts.
Wood, time	{	5 seconds M.L.O., for use with shrapnel shell when time of flight is less than 5 seconds.	
		9 seconds M.L.O., for use with shrapnel shell when time of flight is more than 5 seconds.	
		15 seconds M.L.O., for use with shrapnel shell when time of flight exceeds 9 seconds, or instead of 5 and 9-second fuzes.	

N.B.—Percussion fuzes can be used for shrapnel, and time fuzes for common shell, in exceptional cases.

NOTE.—In places where firing of live shell at annual practice of batteries is permitted, the shells will be loaded and fired as for service. In other places the shells will be loaded with blowing (4-oz.) charges and properly fuzed.

* There are two patterns of these shells in use—one 14·7 inches and the other 16 inches in length.

(A. M.)

Section I.

R.M.L. Ordnance (64-pr.).

WOODEN GARRISON CARRIAGE FOR 64-PR.
CONVERTED GUNS.

Nature.	Standing, Weight.	Rear Chock, Weight.	Sliding.	
			Casemate.	Dwarf.
	cwts.	cwts.	cwts.	cwts.
64-pr., 71 cwt.	14½	14	13½	14½
64-pr., 58 cwt.	14½	13½	11	14

STANDING CARRIAGE.—CONSTRUCTION.

The standing carriage consists of two brackets of oak or teak, two axletrees of African oak, a transom of oak or teak, and four trucks of cast iron, the front 19 inches and the rear 16 inches in diameter.

ALLEN'S BRAKE.

To check the recoil, Allen's brake is applied to each front truck. It consists of a wooden wedge shod with iron attached to the bracket in rear of the truck. A rope lanyard is attached to the wedge, which can thereby be secured, if desirable, so as not to come into action on recoil.

SLIDING CARRIAGE.—CONSTRUCTION.

The sliding carriage differs from standing carriages in having sabicu or African oak blocks instead of axletrees and trucks to take the bearing on the platform. Two 8-inch metal rollers to facilitate running up are secured in wrought iron flanges, bolted upon the front of the front block. An eye or notch for a pawl is fixed in the rear of each bracket to take a roller handspike for running up.

ELEVATING SCREW.

The elevating screw is of the ratchet head and lever pattern.

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**WROUGHT IRON STANDING OR REAR CHOCK
CARRIAGE FOR 64-PR. CONVERTED GUNS.**

Nature.	Weight.	Width between the Brackets.	Trucks.	
			Diam. of Fore.	Diam. of Hind.
	cwt. qrs. lbs.	in.	in.	in.
64-pr., 71 cwt.	17 1 0	26½	20	18
64-pr., 58 cwt.	17 1 0	22½	20	18

CONSTRUCTION.

The body of the carriage consists of two skeleton brackets connected by a fore and hind axletree and by two transom bolts.

The trucks are of elm, shod with a ring tire and bouched with metal.

Cast iron trucks are issued to replace the wooden trucks when not in use, to protect the latter from the effects of climate.

ELEVATING SCREW.

The elevating screw is of the "ratchet head and lever" pattern.

**TRAVERSING PLATFORMS FOR WOODEN
CARRIAGES.**

Traversing platforms are either casemate or dwarf, corresponding to sliding carriages, the difference being in the height to which the frame is raised. The same platform, dwarf or casemate, takes all natures of wood sliding carriages.

WEIGHT.

The casemate platform weighs 27 cwt., the dwarf 33½ cwt.

CONSTRUCTION OF CASEMATE PLATFORM.

It is made of teak, the casemate consisting of two sides, with cheeks, three transoms, one head block, four flanges, and four trucks.

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The sides are $16' \times 1' \times 1'$ placed 21 inches apart; the front trucks are $4\frac{1}{2}$ inch in diameter, the rear trucks 12 inches; the platform is at a slope of 5° .

CONSTRUCTION OF DWARF PLATFORM.

The dwarf platform differs from the casemate in having a block which fits under the sides in rear. The front and rear trucks are 12 inches in diameter. A dwarf platform is readily converted into a casemate, or *vice versa*. The trucks can also be altered in position from one pivot to suit another.

COMPRESSOR.

The compressor supplied for use with wood sliding carriages is termed the "wooden compressor," with the present service charges of the guns mounted on them the recoil is insufficient to necessitate its use.

PIVOTS.

The pivots for wooden platforms are as follows:—

Nature of Pivot.	Distance from Breast of Platform.	
	To Front.	To Rear.
A.	ft. in. 3 11 $\frac{1}{2}$	ft. in. ..
B.	0 2 $\frac{1}{2}$	..
C.	..	6 9
D.	..	9 9
E.	..	11 5 $\frac{1}{2}$
F.	..	13 8 $\frac{1}{2}$

DRILL FOR 64-PR. R.M.L. GUNS, ON COMMON STANDING CARRIAGES.

The detachment consists of 9 Nos. and falls in two deep.

TO TELL OFF.

<u>Officer.</u>		<u>No. 1.</u>
Tell off.	|	

At "Tell off," No. 1 (who is on the left of the detachment) takes a pace to his front, turns to his right, and numbers himself 1, the right hand man of the rear rank numbers 2, the right hand man front rank 3, the second man from the right of the

R.M.L. Ordnance (64-pr.).

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rear rank 4, the man in his front 5, and so on; after the detachment is told off No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery and halted in line facing the parapet, and to the left rear of the platform. The detachment is now in position of "detachment rear."

TO TAKE POST UNDER COVER.

<u>Officer.</u>	<u>No. 1.</u>
<i>Take post under cover.</i>	<i>Right turn.</i> <i>Double march.</i>

The detachment stepping off wheels to its left at the left corner of the platform; the front rank filing to the left of the gun, the rear rank to the right, 2 and 3 halting close to the parapet and near the embrasure; 4 and 5 forming upon their right and left, and the whole turning to the right about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 go to the cartridge store (6 outside) and 7 and 9 to the shell shore (7 outside).

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, directs the gun into the line of fire in running up, and lays.

No. 2 searches, sponges, rams home, runs up, elevates and traverses.

No. 3 loads, uncaps or removes safety pin from fuze when in the bore, rams home, runs up, elevates, and traverses.

No. 4 attends to side arms and supplies them to 2, runs up and attends to the elevating screw and coin in laying.

No. 5 attends to vent, runs up, makes ready, fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes and brings up projectiles.

No. 8 attends to cartridge store and serves out cartridges to 6.

No. 9 attends to shell store, issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

<u>Officer.</u>	<u>No. 1.</u>
<i>Prepare for action.</i>	<i>Prepare for action.</i> <i>Examine gun.</i>

Section I.

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"Prepare for action."

The stores are brought up as follows:—

No. 1, handspike and sights.*

No. 2, handspike and assists 4 with side-arms.

No. 3, handspike and elevating screw, removes the tampon from the muzzle.

No. 4, handspike, side arms, and support for heads of side arms.

No. 5, handspike, tubes in box, lanyard, pricker, and vent server.

No. 6, two cartridge cases, which he leaves at the cartridge store, bucket filled and brush (two drill cartridges for drill purposes).

No. 7, fuzes and fuze and shell implements. He obtains the fuze boxes from 9, having ascertained from No. 1 the nature of fuzes required; he satisfies himself as to the correctness of fuzes and fuze implements.

No. 8 prepares to issue cartridges.

No. 9 provides a brush for cleaning shell, prepares to issue shells, friction tubes, and fuzes, after which he examines the shells carefully, cleaning them if necessary, and removing burrs from studs; he loosens the fuze-hole plugs of shells that will be first issued.

The stores having been brought up, No. 1 will satisfy himself that the foresights fit properly on the gun, that the deflection leaves of the hind sights work easily, and that the platform is properly swept; he receives reports from the Nos. responsible of any irregularity or deficiency in connection with the gun, ammunition, or stores.

The sponge and rammer are laid on the ground clear of the platform, to the right of the gun and parallel to it, heads to the rear, resting on the support supplied by 4, sponge nearest the gun; the shell extractor and wad hook so as not to interfere with the working of any of the guns in the battery, and convenient for the guns for which intended. The sponge bucket near the sponge head.

The handspikes are laid down, two on each side of the platform, close to the carriage, points to the front, bevelled side uppermost; those of 2 and 3 outside and about 2 feet in advance of those of 4 and 5. No. 1's handspike in rear of the platform.

No. 3 examines the bore to see the grooves are free from grit, &c.

No. 4 sees that the elevating screw is properly oiled.

No. 5 straps the tube box round his waist on the right side, coils up the lanyard, and passes the bight of it under the tube box strap, places the pricker in the loop on the side of the carriage, examines the vent-server and places it in the vent, the loop of the vent server lanyard over one of the sights; he fills his box with friction tubes, which he procures from 9.

* 6-foot handspikes are used with this gun.

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If the gun is to be prepared for drill only, 8 and 9 provide and hook a tackle to the eyebolt on the rear axletree and to a holdfast in rear of the gun.

The gun is supposed to be at the rear of the platform.

"Examine gun."

No. 5 drifts the vent, replaces the pricker in the loop and the vent server.

No. 2 supplies himself with the wadhook, searches the gun after the pricker is withdrawn, and replaces the wad hook.

Nos. 4 and 5 take a purchase with handspikes over the cheeks and under the breech, the coin is withdrawn and the elevating screw put in by 3, No. 1 holding up the stool bed with a handspike applied over the bottom step of the carriage. No. 1 gives the order "*Lower*," 4 and 5 withdraw their handspikes, and lay them down.

TO LOAD.

<i>Officer.</i> ——— <i>Range</i> ——— <i>yards.</i> <i>With</i> ——— <i>load.</i>	<i>No. 1.</i> ——— <i>With</i> ——— <i>load.</i>
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"Load."—No. 1 gives 7 the nature of shell and fuze required, and during the loading fixes his tangent scale at the required elevation.

No. 2 places himself in a convenient position for sponging. He places his left foot in line with and about 12 inches from the muzzle, steps to his right with his right foot and looks to his left rear, takes the sponge in a horizontal position from 4, left hand back down, right hand back up, brings it in line with the axis of the gun, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half turns, pressing it against the bottom of the bore, withdraws the sponge hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle, he jerks it out, his hands then should be in the position they were in when he introduced the sponge into the bore. He then hands the sponge to 4 and receives the rammer, right hand about the centre back down, left as near the head as possible back up; as soon as the cartridge and shell are put in, he enters the head into the bore and forces them home hand over hand. He then springs the rammer, steps out, hands it to 4 and goes under cover.

No. 3, as soon as the sponge is withdrawn, takes the cartridge from the cartridge case with his left hand, moves up and places it in the bore, he then slews his body to his right and receives a shell from 7 and puts it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2 and assists him to ram home; when the cartridge and

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projectile are home he quits the stave and goes under cover. Should it appear by the mark on the rammer that the charge is not home, 2 and 3 ram home again.

No. 4 doubles out, halts in line with the sponge head, turns to his left, picks up the stave with his right hand back under, six inches from the head, turns three-quarters left about, and in doing so lifts the sponge over his head, allowing the end of the stave to rest on the ground. His left hand meets the stave close to the sponge, his right hand is slipped up the stave about two feet. He then moves toward the muzzle and passes the stave into the embrasure in such a manner that 2 can conveniently lay hold of it, waiting at the left rear of 2, facing the gun to receive the sponge. When he receives the sponge from 2, he allows the end of the stave to fall on the platform, steps to his left, turns three-quarters right about, passing the sponge over his head, lays it down, takes up the rammer as before detailed for the sponge, and hands it to 2. He then remains in position to receive the rammer, which he does as soon as 2 has sprung it. He lays it down as he did the sponge and goes under cover.

No. 6 brings up a cartridge in a case and places it on the ground on 3's right front; after the sponge is withdrawn he uncovers it, and as soon as 3 has withdrawn the cartridge, he goes back to the cartridge store.

No. 7 brings up a shell, point to his right, having fixed the fuze according to No. 1's directions, and hands it to 3.

No. 8 issues a cartridge to 6.

No. 9 issues a shell to 7.

To RUN UP.

Officer.

No. 1.

Run up.
Halt.

Directly the gun is loaded, No. 1 gives "*Run up*" and applies his handspike under the rear axletree to guide the gun.

Nos. 2, 3, 4, 5, take up their handspikes at the centre, with the hands next the parapet back up, the other hands at the small ends back down; stepping up to their respective axletree arms, they apply their handspikes under and in rear of them, and stand ready to heave, taking the time from 2, and using short quick purchases they heave together until the front trucks nearly touch the hurter, when No. 1 gives "*Halt*," slides his handspike to the rear, clear of the recoil, and looks over the sights, steadying himself by leaning on the cascable.

Nos. 2, 3, 4, and 5 withdraw their handspikes, drop the points to the ground; 4 and 5 lay theirs down; 2 and 3 turn to the rear and step outwards, holding their handspikes diagonally across the body, outward hands at the small ends as high as the ear, inward

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hands resting on the handspike at the full extent of the arm, bevelled side of the handspikes uppermost; 4, kneeling on his left knee in rear of the right cheek, takes hold of the large coin with both hands, or the small coin with his left hand, or works the screw as may be directed by No. 1; the screw should be used only for final adjustment; 5 goes under cover and prepares a tube.

TO LAY THE GUN. (See SECTION IV.) page 336.

Officer.

No. 1.

Elevate.

Lower.

Coin.

With screw, Elevate. Halt.

Depress, Halt.

Trail (right). Halt.

Trail (left). Halt.

No. 1, looking over his sights, gives "*Elevate*," then "*Lower*," and when the gun is at the required elevation "*Coin*." If a slight amount of elevation or depression is required, he gives "*With Screw*," "*Elevate*," or "*Depress*."

"*Elevate*," 2 and 3 step forward in line with the breech, place their handspikes, bevels down, over the steps and under the breech, and bear down; at "*Lower*," they allow the small ends to rise gently; at "*Coin*" they withdraw their handspikes and step outwards; 4 withdraws the coin as soon as 2 and 3 elevate, and at "*Coin*" forces it sharply home. If the order is "*With Screw*," "*Elevate*," or "*Depress*," 4 works the screw until "*Halt*" is given. The other numbers stand fast.

If the muzzle is to go to the left No. 1 gives "*Trail right*," and when the muzzle is sufficiently to the left, "*Halt*." At "*Trail right*" 2 moves round on his right foot to the rear of the axletree arm and applies his handspike under it to row; 3, stepping to his left, takes a purchase under the rear of the cheek and stands ready to heave over the trail. They heave together until the order "*Halt*," and remain there steady till the next order is given.

"*Trail left*" is the converse of the above. If much traversing is required the order is "*Extreme right*" or "*Extreme left*." In this case 4 or 5, according to the side, takes a purchase in front of the rear truck in addition to the other numbers.

Should no order to fire be given when the gun is laid, No. 1 will give the word "*Under cover*."

TO MAKE READY AND FIRE.

Officer.

No. 1.

Fire — rounds.

No. — Ready.

No. — Fire.

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No. 1 lowers his tangent scale, except when firing at a moving object, and gives "*Ready*;" 5 presses the tube into the vent with his right thumb, passes the lanyard through the rear eye bolt of the carriage, steps clear of the recoil, shifts the lanyard to his right-hand and extends it, facing the gun.

As soon as "*Ready*" is given, 2 and 3 lay down their hand-spikes and with 4 go under cover.

At "*Fire*" 5 draws the lanyard strongly towards his body, without a jerk; he then drifts the vent, replaces the vent server and pricker, and goes under cover, replacing the lanyard under his belt.

No. 1 does not again give "*Load*" until 5 has replaced the vent server.

TO RUN BACK AND UNLOAD.

Officer.No. 1.*Run back.**Halt.**Unload.*

When the vent has been drifted and the vent server placed in the vent, at "*Run back*" the detachment double out and man the fall of the tackle arranged by 8 and 9 for the purpose, and heave the gun back into the position for loading, No. 1 giving "*Halt*," "*Unload*," when the gun is sufficiently run back. On this order the gun is unloaded, 2 and 3 withdrawing the charge, 4 supplying the necessary side arms.

TO CEASE FIRING AND REPLACE STORES.

Officer.No. 1.*Cease firing.*
*Replace stores.**Elevate.*
Lower.
Coin.
Replace stores.

"*Cease firing*," "*Replace stores*," No. 1 gives "*Elevate*," and the gun is laid under metal by 4 and 5, he then gives "*Replace stores*" and the stores are replaced by the numbers who brought them up.

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TO FORM DETACHMENT REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Outwards turn.</i>
	<i>Double march.</i>
	<i>Halt.</i>
	<i>Front.</i>

"*Detachment rear*," No. 1 doubles to the left rear of the platform, faces to the left, and gives the order "*Outwards turn*;" 2 and 4 turn to their left, 3 and 5 to their right.

"*Double march*," 4 and 5 followed by 2 and 3 wheel to the right and left, and when clear of the platform to the right, and round No. 1's left shoulder, 6, 7, 8 and 9 coming up into their places; when 2 and 3 have passed him No. 1 gives "*Halt*," "*Front*," and changes his flank by the rear.

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change Rounds.</i>	<i>Change Rounds.</i>

In changing rounds No. 2 becomes 4; 4, 1; 1, 9; 9, 8; 8, 7; 7, 6; 6, 5; 5, 3; 3, 2.

R.M.L. ORDNANCE ON REAR CHOCK CARRIAGES.

Guns mounted on rear chock carriages require the same detachment and stores as those on common standing carriages, with the exception of one roller handspike provided by No. 1 and two 7-foot handspikes by 2 and 3, instead of five common handspikes.

The drill is also the same, with the following exceptions:—

In running up, No. 1, holding his roller handspike vertically, takes a purchase under the socket in rear of the chock, bears down and raises it off the platform, keeping a firm hold of the handspike to prevent its flying up, which gives him a perfect control over the carriage and enables him to guide it. When the platform is in good order the gun runs up very fast. No. 1 in that case allows the small end of his handspike to "come up" just before the trucks reach the hurter. As soon as the gun is run up, No. 1 releases his roller handspike, takes it by the centre with his right hand and slides it well to the rear clear of the recoil.

In running up, 2 and 3 apply their handspikes at the axletree

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arms assisted by 4 and 5. As soon as the gun is up the handspike men turn to the rear in line with the vent.

"*Elevate*," 2 and 3 apply their handspikes, 5 double-manning 3's, 4 attending to the coils.

"*Trail Left*," 2 applies his handspike under the right cheek behind the chock.

"*Trail Right*," 3 applies his handspike in a similar manner under the left cheek.

"*Extreme Right*," or "*Extreme Left*," the numbers all go to one side and heave over, applying their handspikes behind the cheek.

The running back is performed by means of tackle, No. 1 applying his roller handspike as in running up, and the rest of the Nos. running away with the fall.

64-PR. R.M.L. ON MONCRIEFF CARRIAGE.

THE CARRIAGE AND PLATFORM. MARK II.

The 64-pr. carriage is the same as that for the 7-inch gun, described page 228, but the sides of the platform are of girder iron 10 inches deep, 5½ inches wide in the flange, and 15 feet long, but placed 2 feet 2½ inches apart. There is but one brake-wheel upon the left of the platform; the elevator is moved by iron-pointed levers, working in capstan heads, one upon each end of the brake-shaft. The platform has but three trucks, one 2 feet in diameter, in rear, and two 1 foot 6 inches diameter in front; they are moved by iron-pointed or shod levers. The gun when mounted will fire over a parapet 9 feet 4 inches high.

DRILL WITH 64-PR. R.M.L. (CONVERTED GUN) OF 58 CWT. ON MONCRIEFF CARRIAGE. MARK II.

The detachment, consisting of 9 Nos., is told off and takes post under cover, as with the same gun mounted on a traversing platform.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, attends to the brake in running up, and lays.

No. 2 searches, sponges, places projectile in bore, rams home (attends to lever if required), and elevates.

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No. 3 loads, uncaps or removes safety pin from fuze when in the bore, rams home (attends to lever if required).

No. 4 attends to side-arms, supplies them to 2 (attends to lever if required).

No. 5 attends to vent, supplies wedgewads, traverses (attends to lever if required), makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes, and brings up the projectile.

No. 8 attends to cartridge store, serves out cartridges to 6.

No. 9 attends to shell store, issues shell, tubes, and fuzes.

TO PREPARE FOR ACTION.

As with the gun on a traversing platform, except no preventor rope, handspikes, truck levers, or iron-shod levers, are required. No. 5 provides a long lanyard.

A sponge, with wire rope stave, and a jointed rammer are used.

2 and 3 bring up an iron pointed lever each, which they lay down on each side of the gun.

Tackle will be necessary to run the gun back. Two sets of light gun tackle are brought up by 6 and 7.

The sponge and rammer are laid down on the right of the gun, close to the parapet, heads towards the muzzle, the shell extractor and wadhook outside the pit.

At "*Examine Gun*," same as at 64-pr. R.M.L. on a traversing platform, except 4 supplies 2 with the wadhook, and replaces it, and 2 attends to the elevating wheel and depresses, after the gun has been searched, until the muzzle is in a convenient position for loading.

TO LOAD.

As with the gun on a traversing platform, except as follows:—

No. 1 at "*Load*" gets the gun into a convenient position, *i.e.*, the upper edge of counterweight nearly horizontal; 2 depresses the gun, if necessary.

After the loading is completed, 2 gives 1° or more of elevation, as shown on the arc.

TO RUN UP.

Before running up, No. 1 will give the caution "*Stand Clear*;" then, holding the brake, he allows the gun to run up.

He must be very careful not to let it escape from his control, and on the other hand he must not check it too soon. Should the latter be the case, No. 1 gives "*Work Levers*," 2 and 3 fix the latches and work their levers, small ends to the rear; 2 and 4 man the right, 3 and 5 the left lever; No. 1 will give "*Down*," "*Fresh Purchase*," "*Halt*," as required.

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When the gun is up, No. 1 will mount up the ladder to lay it, 2 and 3 slackening the latches and unshipping the levers; 5 mans the traversing handle.

TO LAY THE GUN.

5 traverses.

2 elevates or depresses.

The gun may be laid without exposing any number, No. 1 using a reflecting sight or elevating in accordance with the graduations on the elevating arc or trunnion pointer, and traversing to marks previously made on the carcers.

TO MAKE READY AND FIRE.

When No. 1 has laid the gun, at "*Ready*," 5 mounts up and drops the tube into the vent, throwing the lanyard clear of the carriage, and comes down.

When the gun is laid from below, No. 5 makes ready before the gun is run up. As soon as he has fired he drifts the vent, replacing the vent server and prickler, and coiling up the lanyard.

TO UNLOAD AND RUN BACK.

(For drill purposes extra men will be required).

To run back, 2 and 3 fix the latches and work their levers, small ends to the front, and bear down, double-manned by 4 and 5, No. 1 giving "*Down*," "*Fresh Purchase*," "*Halt*," as required.

Tackles to be hooked by 4 and 5, assisted by 6 and 7, and manned by all available Nos.

Unloading should be effected from the firing position before the gun is run back.

TO CEASE FIRING AND REPLACE STORES.

TO FORM DETACHMENT REAR.

TO CHANGE ROUNDS.

As with 64-pr. R.M.L. on traversing platform.

80-PR. R.M.L. CONVERTED GUN.

DESCRIPTION.

				ft.	in.
Length	{ nominal	10	0
	{ of bore	9	5.25
	{ of rifling	8	10.25

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Preponderance	..	9 cwt., 3 qrs., 4 lbs.
Calibre	6.3 inches
Nominal Weight	5 tons
Grooves	3
Twist of rifling	.. ..	uniform 1 in 40

GENERAL OBSERVATIONS.

The 80-pr. R.M.L. converted gun for land service is met with for defence of land fronts, and for coast defence against wooden shipping.

MODE OF CONVERSION.

Its mode of conversion from the 68-pr. S.B. of 95 cwt. is identical with that of the 64-pr. of 58 cwt.

These guns are examined after every 150 rounds.

RIFLING.

The rifling, however, is on "the Woolwich system," the width of the groove being 1.3 inches, and depth 0.145 inch. Case shot is, therefore, the *only* projectile interchangeable with the 64-pr. gun.

VENTING.

The 80-pr. is vented in the same manner as the 64-pr. 58-cwt. gun.

SIGHTING.

The 80-pr. is side-sighted, and has drop trunnion sights; the tangent scales are fitted with deflection leaves, and are graduated and marked in a similar manner to the sights for the 64-pr. of 71 cwt.

PROJECTILES.

		Weight.	
		lbs.	oz.
Shells	Common { empty	71	1
	filled with 8 lb. 13 oz. bursting charge	79	14
	Shrapnel { filled with 288 bullets and 9 oz. bursting charge	78	6
	Shot case, filled with 50 8-oz. sand shot, clay and sand	32	0

Common shell is used on land fronts against earthworks, buildings, &c., on sea fronts against shipping.

Shrapnel shell is used when the range is beyond the effective power of case shot; on land fronts against bodies of troops; on sea fronts against boats. Case shot is used for close quarters against troops or boats. Two can be used on emergencies at close quarters.

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CHARGES.

Full or Service 10 lbs. L.G. or R.L.G.
 Velocity 1,240 feet (muzzle).

FUZES.

Percussion	{ Pettman G.S. } { R.L. Mark II. }	for use with common shell	{ sea fronts. { land fronts.
Wood, time	{ 5-seconds M.L.O., for use with shrapnel shell when time of flight is less than 5 seconds. 9 seconds M.L.O., for use with shrapnel shell when time of flight is more than 5 seconds. 15-seconds M.L.O., for use with shrapnel shell when time of flight is more than 9 seconds, or in lieu of 5 or 9-second fuzes.		

N.B.—Percussion fuzes can also be used for shrapnel and time fuzes for common shell in *exceptional* cases.

WOODEN GARRISON CARRIAGE, 80-PR. (CONVERTED) GUN.

CONSTRUCTION.

The wooden rear chock and sliding garrison carriages for this gun are similar in construction to those described for the 64-pr.

They weigh as follows:—Rear chock, 19½ cwt.; sliding, casemate, 15½ cwt.; sliding, dwarf, 16½ cwt.

Wrought-iron carriages are not supplied for this gun.

TRAVERSING PLATFORM.

The descriptions of traversing platforms for 64-pr. guns apply equally to the 80-pr., as the same platform, dwarf or casemate, takes all natures of wood sliding carriages.

DRILL FOR 64-PR. and 80-PR. R.M.L. GUNS ON TRAVERSING PLATFORMS.

The drill is the same as for 64-prs. on common standing carriages, except in the details hereafter specified.

The detachment consists of nine numbers. The additional stores required are two sets of tackle, one preventor rope, two truck levers, two iron shod levers; two handspikes only are required. With the 64-pr., luff tackles; with the 80-pr., light gun tackles, 7-foot handspikes, and one shell-bearer should be provided.

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GENERAL DUTIES.

No. 1 commands, directs or superintends boring and fixing fuzes, holds on to the preventor rope and lays.

No. 2 searches, sponges, rams home, runs up, elevates and traverses.

No. 3 loads, uncaps or removes safety pin from fuze when in the bore, rams home, runs up, elevates, and traverses.

No. 4 attends to side arms, and supplies them to 2, runs up, attends to the elevating screw and coin in laying.

No. 5 attends to vent, supplies wedge wads, runs up, holds on to preventor rope, makes ready, and fires.

No. 6 supplies 3 with cartridges (and with 80-pr. brings up projectiles.)

No. 7 attends to fuzes and brings up projectile.

No. 8 attends to cartridge store and serves out cartridges to 6.

No. 9 attends to shell store and issues shells tubes and fuzes.

TO PREPARE FOR ACTION.

"To prepare for action."—No. 1 provides and fixes sights and preventor rope, which he attaches to the carriage, assisted by 3 (if necessary), takes two turns with it round the bollard, the running end coming off to the left at the top.

No. 2, handspike, truck lever, iron shod lever, and assists 4 with side arms.

No. 3, handspike, truck lever, iron shod lever, and elevating screw. Removes muzzle tampeon.

No. 4, side arms and support.

No. 5, wedge wads, tubes in box, lanyard, pricker and vent server.

No. 6, two cartridge cases (which he takes to the cartridge store), bucket filled and brush, two drill cartridges for drill purposes.

No. 7, fuzes, fuze and shell implements, one set of tackle (and with 80-pr. a shell bearer).

No. 8 prepares to issue cartridges.

No. 9, one set of tackle and a brush for cleaning projectiles. Prepares to issue shell, tubes, and fuzes.

The handspikes and iron shod levers are laid down bevelled sides uppermost; the handspikes next the gun, the truck levers between them, the whole with their points to the front.

The standing blocks are hooked by 7 and 9 to the rear eye-bolts of the platform, the tackles rounded in, and the ends of the falls coiled down.

"Examine gun."—No. 5 drifts the vent, replacing the pricker and vent server, 4 and 5 take a purchase with their handspikes over the cheeks and under the breech, and bear down.

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With the 80-pr. 2 double man's 4's handspike; the coin is withdrawn and the elevating screw put in by 3, No. 1 holding up the stool bed with an iron shod lever applied over the bottom step of the carriage. No. 1 gives "*Lower*," when 4 and 5 withdraw their handspikes and lay them down; 2 supplies himself with the wad hook, searches the gun, after the pricker is withdrawn, and replaces the wad hook.

TO LOAD.

No. 2 mounts on the side piece, and places himself in position for sponging.

No. 3 mounts on the step to put in the cartridge, and on the platform to put in the projectile, and a wedge wad after they have been rammed home, 2 and 3 pressing it steadily home, jamming it under the head of the projectile by two smart taps.

With 80-prs. 6 and 7 bring up projectiles in bearer, 6 carrying the cartridge case in his right hand. The bearer is placed on the front of the platform, and 7 removes it when the shell has been placed in the bore by 2 and 3.

TO RUN UP.

"*Run up*."—No. 1 takes in the slack, and holds on the preventor rope; 2, 3, 4, and 5 take up the truck levers; 2 and 3 raising the small ends to enable 4 and 5 to hook the points to the eye-bolts. When this is done 2 and 3 haul down the small ends by means of the ropes; 4 and 5 place the pawls; 4 goes under cover; 5 holds on to the preventor rope behind 1; 2 and 3 guide the levers whilst the carriage is in motion.

Nos. 1 and 5 ease off, hand-over-hand, and hold on when the mark on the preventor rope comes over the bollard.

When the gun is in its proper position No. 1 gives "*Halt*," when 2 and 3 heave down the small ends of the levers; 4 and 5 throw back the pawls; 2 and 3 allow the small ends of the levers to rise gently, manning the ropes when the levers are above their reach.

When the rear of the carriage rests upon the platform the levers are unhooked, withdrawn, and laid down outside the handspikes by 2, 3, 4 and 5, 4 tightening the compressor if the carriage is fitted with one; 2 and 3 pick up their handspikes, and stand ready to elevate (at the 80-pr. 5 double manning 3's handspike); 4 attending to the coins and elevating screw.

5 unhooks and takes in the slack of preventor rope.

TO LAY THE GUN.

The gun is elevated in the same manner as when mounted on a standing carriage; on No. 1 giving the word "*Coin*," 2 and 3

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lay down their handspikes, and take up the iron shod levers to traverse; 5 prepares a tube.

As these platforms are pivoted in front, in rear, or in the centre, the position taken up by 2 and 3 differs according to the manner in which the platform is pivoted.

*Nature of Pivot.**Position of Nos. 2 and 3.*

Pivot "A" (under the muzzle of the gun when run up).

"Trail right."

2 stands facing to the rear with the point of his lever resting on the rear racer; at "*Halt*" he scotches the rear truck his own side with the lever.

3 stands facing to the rear and applies the point of his lever under the left rear truck of the platform, both hands back up, and heaves the platform over to the right, taking short quick purchases.

"Trail left."

The numbers work in the opposite directions.

Pivot "B" (under the front part of the platform).

As with "A" Pivot.

"Trail right."

3 works as with pivot "A;" 2 takes up his position at the front truck on his own side, and works over the front of the platform to the left. At "*Halt*," 2 withdraws his lever and with it scotches the rear truck.

"Trail left."

3 works the front truck, and 2 the rear, 3 scotches the rear truck at "*Halt*."

Pivot "C" (in the centre of the platform).

Trail right or left.

2 and 3 work the front truck, 2 heaving the front of the platform over to the left in the first case, 3 the front to the right in the second.

Pivot "D" (at an intermediate point between the centre of the platform and the rear truck).

Pivot "E" (in front of the rear block).

As with "D" Pivot.

Pivot "F" (in the rear of the rear block).

As with "D" Pivot.

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R.M.L. Ordnance (64-pr. and 80-pr.).

With platforms pivoted at "A" or "B;" at "*Extreme right*" (or *Left*) 2, 3, 4 and 5 push over the rear of the platform in the direction ordered.

When traversing tackle is used; at "*Hook traversing tackle*" 4 and 5 hook the double blocks to the rings or holdfasts prepared for them; 2, 4, and 3, 5, haul on the tackle, or ease off at "*Trail right*" (or *Left*), so as to move the platform in the direction required.

If the tackle when hooked hinders the service of the gun the double blocks are removed by 4 and 5, or the single ones by 2 and 3, as may be directed by No. 1.

TO MAKE READY AND FIRE.

At "*Ready*," 2 and 3 withdraw their levers, and place them, bevels up, as scotches under the trucks, 2, 3, and 4 then go under cover. No. 5 presses the tube into the vent, descends from the platform, passes the lanyard through the rear eye bolt of the carriage, and stands ready to fire facing the gun; immediately after firing he drifts the vent, replacing the vent server and pricker, coiling up the lanyard and placing it under his belt.

RUN BACK.

"*Run back*," 4 slackens the compressor if the carriage is fitted with one.

The truck levers are applied as in running up; No. 1, standing between the cheeks, holds the small ends of the truck levers and guides them; 4 and 5 overhaul the tackle and hook the front blocks to the front eye-bolts on the carriage. All the numbers, except No. 1, man the falls on their respective sides, and at "*Heave*" haul the gun back.

When the gun is run far enough back, No. 1 hauls down the levers by the ropes till the pawls fall; the levers are then allowed to come up, No. 1 rising with them. The front blocks are unhooked by 4 and 5, who carry them to the rear, overhaul them, lay them down clear of the racers, and coil down the end of the falls. No. 1 takes in the slack of the preventor rope; 2, 3, 4, and 5 unhook the truck levers and lay them down.

R.M.L. Ordnance (7-inch).

Section I.

7-INCH R.M.L. GUN OF 7 TONS (L.S. ONLY).

	Mark I.	Mark III.
Calibre	7 inches ..	7 inches
Nominal weight ..	7 tons ..	7 tons
Preponderance ..	.. ..	2 cwts. 3 qrs. 2 lbs.
Length { of bore ..	.. ..	10 feet 6 inches
{ of rifling ..	.. ..	9 feet 2.5 inches
{ total ..	12 feet 6 inches ..	12 feet 4 inches
Rifling { grooves Number ..	3 ..	3
{ spiral, uniform ..	1 in 35 calibres ..	Uniform, 1 in 35 calibres
Chamber	Cylindrical ..	Conical
"A" tube	Toughened steel	
"B" tube		
	Coiled iron	

DIFFERENT PATTERNS.

There are actually four patterns of this gun. Of Mark II., however (which are marked FI. on the left trunnion), only two were made.

CONSTRUCTION OF MARK I.

Mark I. was introduced in 1865 as a battering gun for coast defence. It is of the Armstrong, or original construction, on which system all B.L.R. guns, and the earliest R.M.L. guns, viz., 64-pr., 7-inch, 8-inch, 9-inch, and 12-inch of 25 tons (all of Mark I.), were made until the year 1867. The 7-inch Mark I. consists of: A tube; breech piece and B tube; trunnion ring; five coils; cascable.

Although this construction gave good results, it was expensive, both from the quality of the iron required, and from the number of pieces to be made and put together for each gun.

FRASER CONSTRUCTION.

The plan proposed by Mr. R. S. Fraser, of the Royal Gun Factories, was consequently adopted in 1868, differing from the original construction in the gun being built up of a few large and comparatively heavy coils instead of several short ones and a forged breech piece.

The 7-inch Mark III., and all R.M.L. guns of the patterns now being manufactured (except converted guns), are built up in this manner. That is to say, over a barrel (or "A" tube) of steel are shrunk a certain number of coils or other pieces of wrought iron, according to the size of the gun, while a cascable is screwed into the end of the coil which comes over the breech end of the

Section I.

R.M.L. Ordnance (7-inch).

tube, and fitting closely against the solid end of the barrel supports it firmly. The 7-inch Mark III. consists of: A tube; breech piece; B tube (chase); breech coil; cascable. The points in which Mark IV. differs from Mark III. are a slight increase in thickness of the steel tube at the breech end, and the putting on of the first layer of iron in the shape of a coiled breech piece, a 1B coil and a B tube, and a consequent modification in the C coil.

EXAMINATION, &C., OF GUNS.

The guns will, as far as possible, be examined regularly after every 100 rounds with projectiles, by the Inspector of Warlike Stores at stations where there is one; at other stations under the direction of the Officer commanding the Royal Artillery in the district.

The bores of guns from which practice is carried on, should be kept slightly oiled to prevent rusting. At the close of each day's practice they will accordingly be washed out and placed under metal, and, as soon as dry, will be oiled with a sponge, and the muzzles closed with tampons. When guns are not in use the bores will be lacquered.

RIFLING.

The rifling is on the "Woolwich system," adopted for all R.M.L. guns from 25-pr. upwards, excepting the 64-pr.

The 7-inch, however, differs from other guns in having a uniform spiral.

The grooves are 1.5 inches wide at the top, and .18 inch deep.

VENTING.

The 7-inch gun is vented with a cone or through vent bush of hardened copper, the position of which is so regulated that the bush strikes the surface of the bore $\frac{1}{10}$ ths of the length of the cartridge from the bottom.

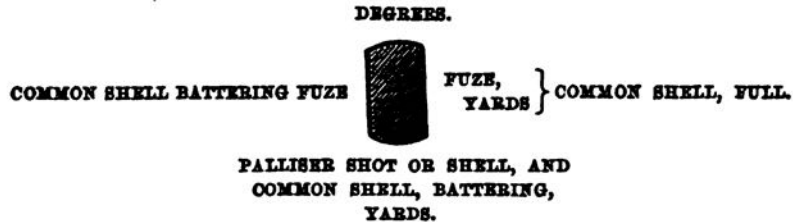
SIGHTING.

The gun is provided with six sights, viz., two tangent sights, one on each side, graduated up to 15°. The scale is four-sided, and is marked as follows:—

R.M.L. Ordnance (7-inch).

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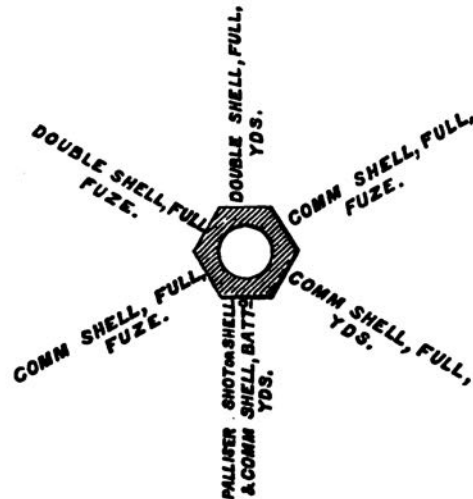
7-INCH MARK III., § 2198.



The tangent sights are provided with deflection leaves, the scale of which allows of 30' deflection being given right or left.

One centre hind sight. This is a scale for use at close quarters, and for double shell. It works in a gun metal socket fixed in the gun, and is provided with a set screw, is hexagonal and marked as follows:—

7-INCH MARK III., § 198.



Two trunnion sights. The sight consists of a pillar, collar, and socket of gun metal, a steel leaf and screw for fixing the leaf. The socket is permanently fixed in the gun; the pillar and collar each lock into it with a bayonet joint, so that when once the sight is in its true position it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle to the left.

One centre foresight. Similar to the trunnion sight.

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R.M.L. Ordnance (7-inch).

PROJECTILES.

		Weight.
		lbs. oz.
Shot	Case, filled with 71 8-oz. sand shot, clay and sand	69 6
	Palliser { empty	113 3
	{ with 11lb. 10-oz. bursting charge ..	114 13
Shells	Common { empty	108 0
	{ with 8lb. 12oz. bursting charge ..	116 12
	Double* { empty	145 9
	{ with 10lb. 12oz. bursting charge ..	156 5
	Palliser { empty	112 2
	{ with 21lb. 8oz. bursting charge ..	114 10
Shrapnel { Filled with 192 2-oz. sand shot and 12 oz. bursting charge ..		118 0

Gas check, weight of.

Case shot is used for close quarters against troops or boats.

Palliser projectiles. Both shot and shell are used against ironclads.

Common shell is used against shipping, as also double shell at close quarters.

If required the common shell can be used with battering charges.

CHARGES.

Battering	..	..	30lbs. P. or 22lbs. R.L.G.
Full	..	..	14lbs. R.L.G.

7-INCH R.M.L. GUN OF 6.5 TONS.

Charge 30 lbs. P. Powder. Projectile, without Gas-check, 115 lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1525	1855	85
500	1382	1524	69
1000	1261	1268	58
1500	1159	1071	48
2000	1078	927	43
2500	1019	829	37.5
3000	973	755	35

FUZES.

Time, 15-seconds M.L.O. for use with shrapnel shell.

Percussion, Pettman, general service, for sea fronts for use with common and double shell.

* Gas check for double shells, vide Changes in Material, 3374.

R.M.L. Ordnance (7-inch).

Section I.

TABLE OF WEIGHTS, &C., OF CARRIAGES OF 7-INCH OF 7-TON GUN.

Nature.	Weight. cwt. qrs.	Diameter of Rollers.	
		Front.	Rear.
7-inch M.L.R., single plate	casemate .. 27 3	10 inches.	6 inches.
	dwarf .. 29 0	10	6
" double plate	Fitted for compressor } 30 3 (with gear)	10	6
	Fitted for buffer .. } 27 1 "	10	6

CARRIAGES.

Sliding carriages for 7-inch guns and upwards are now constructed of wrought-iron, and of which there are two distinct constructions in the service.

The first patterns are of the single-plate construction, where the brackets are formed of a single plate of iron riveted to an open framework of angle iron.

The last pattern is of the double-plate construction, where the brackets are formed of two plates of iron riveted to a framework of bar-iron fitted between them.

The compressor arrangements of the single-plate carriages are those known as the American and Elswick patterns. The American is worked by hand-wheels fitted on the outside of each bracket. The compressor plates, six in number, are strung on pins from angle plate bolted to the blocks, and hang down between five wooden baulks fitted down the middle of the platform, the centre baulk alone being a fixture. By turning the hand-wheels on both sides of the carriage, the shafts are screwed into the metal nuts which travel along the screws, and draw with them the upper arms of the rocking lever outwards, thereby forcing the lower arms inwards against the outer compressor plates, and thus jamming the whole of the plates and moveable baulks together against the fixed centre baulk. It is necessary with this compressor to tighten up both screws before every round, and slacken them before running up.

In the Elswick compressor the baulks are replaced by six bars of wrought-iron plate, all moveable; the screw shafts are worked by iron levers in place of hand-wheels. The screws on the shafts are of a different pitch; that on the right side is called the compressor screw, and has a quicker pitch than the one on

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R.M.L. Ordnance (7-inch).

the left, which is called the adjusting shaft. The compressor screw for double plate is made with right and left hand threads.

It is only necessary to work one of the screws before and after every round. By pushing down the compressor lever a quarter of a circle, the whole of the compressor plates and bars are jammed together by the right rocking lever against the opposite or left rocking lever, the position of which is adjusted by the lever of the adjusting shaft, according to the amount of compression required.

Double-plate carriages are employed either as dwarf or case-mate, the difference in height being given by the platform.

They are now fitted with hydraulic buffers instead of Elswick compressors, and some of the carriages have elevating gear consisting of a worm-wheel and shaft instead of the capstan head and lever.

Each carriage consists of:—

2 brackets,	1 rear eccentric shaft with
1 front transom,	two rollers, and 2 sockets, lever,
1 bottom plate, with angle	2 front clip plates,
guides and stays,	Elevating gear,
2 capsquares with keys,	Compressor gear, or bracket
2 front rollers with axles and	for hydraulic buffer.
$\frac{1}{4}$ -inch split keys,	

On the right and left brackets a reader or small block of gun-metal with pointer is attached by two screws for use in connexion with the index plate attached to the breech of the gun.

The capsquares are interchangeable and reversible on both sides of the carriage.

The clip plates prevent the carriage from jumping up when the gun is fired. They are fitted one on each side through slots cut in the angle-guides beneath the carriage, and secured each by two bolts through the bottom, which they clip to the upper flange of the platform girders. Before the carriage can be dismounted from the platform, the clip plates must be removed.

In order to preserve the carriages in a proper working condition, the axles, spindles, pinions, compressor and adjusting nuts, compressor screw, adjusting shaft, rocking levers, &c., and also their bearings, must be kept clear of clotted oil and rust, and kept well lubricated. The compressor plates and bars are on no account to be oiled or greased; they should be scraped to prevent deterioration from rust; a little superficial rust is not detrimental, as it tends to create friction.

In putting the gear on a carriage, should a screw go very tight it must be withdrawn and examined, and if it is found that the bearing or screw has been indented, the burr must be carefully removed with a file.

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CAPSTAN HEAD ELEVATING GEAR.

1. The pinion with spindle, capstan head, and jamming lever, will fit on either bracket, but must be placed on so that the lever will clamp by turning it to the rear, and the boss of capstan placed next the brackets.

2. The pinion spindle is placed through the bracket from the inside, the capstan placed on the spindle outside the bracket, boss inwards, the feathers entering the feather-ways in the spindle, and the jamming levers placed on. These articles are placed similarly on each bracket.

3. The elevating arc may be placed on, either before or after the gun is mounted, but it is more convenient to place it on after the gun is mounted; it is less likely to be damaged, and more out of the way.

The top of each arc is marked "top," which end should be placed uppermost; it will then suit only the side to which it belongs. The object of marking the "top" is to keep the arc in the position to give the requisite elevation and depression, as the length of the arc is shortest above the pivoting screw.

The arc is pivoted to the patch on the gun by a screw, which is marked "R" or "L" (right or left), and when the screw is screwed home, a keep-pin is placed vertically through it and the patch.

ELSWICK COMPRESSOR ON DOUBLE-PLATE CARRIAGES.

The adjusting lever is secured at any position on the arc by means of a key; on throwing down the compressor lever into the catch on the arc, both the compressor and adjusting nuts travel outwards along the compressor screw, carrying with them the upper ends of the rocking levers, thereby forcing the lower ends inwards against the plates on the carriage and jamming them against the bars on the platform, which are thus compressed tightly together; the friction produced between them on the discharge of the gun checks the recoil. The amount of compression is regulated by the position of the adjusting lever along the arc.

TRAVERSING PLATFORMS.

Traversing platforms for all guns of 7 tons and upwards are constructed of wrought iron, and are dwarf or casemate.

For single plate carriages, the same platform is suitable for either 7 or 9-inch.

For double plate carriages, one platform is required for each nature, which was formerly fitted to receive the Elswick compressor, but now the hydraulic buffer.

Section I.

R.M.L. Ordnance (7-inch).

The platform is 15 feet in length, and has a slope of 4° .

It is fitted with brackets on the side for the reception of the sponge, rammer, and iron pointed levers. A water tank is attached to the rear of the right side of platform for wetting the sponge head.

TABLE OF WEIGHTS, &C., OF PLATFORMS FOR 7-INCH 7-TON
R.M.L. GUN.

	Weight.	Width between sides.	Diameter of Trucks.	
			Front.	Hind.
	cwt. qrs.	ft. in.	in.	in.
7-inch R.M.L. Platform for { casemate ..	55 2	2 10½	6	10½
single plate carriages .. { dwarf.. ..	69 2	..	10½	15½
	(with gear)			
7-inch R.M.L. { casemate fitted for compressor	55 2	2 10½	8½	13
Platform { ditto with buffer ..	52 1	2 10½	..	..
for double { dwarf, "A" ..	77 0	2 10½	18	24
plate { "C" ..	80 0½	2 10½	24	24
carriages { "D" ..	80 3	2 10½	24	18

HYDRAULIC BUFFER.

The object of using the buffer is to reduce the recoil of the carriage within the desired limits, which is accomplished as follows:—

The cylinder being rigidly fixed to the platform, and the end of the piston rod fixed to the front of the carriage, when the carriage is run up, the piston-rod is drawn out of the cylinder nearly its full length, and the piston drawn to the front end of the cylinder, and the oil passed to the back of the piston. As the carriage recoils it forces the piston-rod with the piston up the cylinder, the resistance to its passage by the oil checking the recoil; the oil passes from the rear to the front of the piston through the holes in it, therefore, the size of the holes is regulated to suit the velocity of the recoil: the larger the gun the smaller the holes must be. The resistance offered by the oil increases with the velocity of the piston, and *vice versa*.

The cylinder not being entirely filled with oil, the air in that space causes it to act as an elastic buffer.

The same buffer is adapted for use with all heavy rifled M.L. guns from 7-inch to 12-inch of 25 tons by varying the size of piston holes.

R.M.L. Ordnance (7-inch).

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* Four holes, 0.9 inch diameter, are drilled in the piston to allow of the passage of the oil; when full charges are used the recoil may be adjusted by diminishing the quantity of oil in cylinder.

To fill the cylinder with oil, run the carriage up to the stops, take out the screw plug and rest the gallon measure in the hole, turn off the cock and fill the measure with mineral oil to the gallon mark, then turn the cock and allow the oil to flow into the cylinder; repeat the operation until the quantity required is run in. The greatest quantity of oil used should not exceed 12 gallons, which, with the carriage run out, will be $4\frac{1}{2}$ inches deep at the filling hole; this depth may be easily tested by a slip of wood: oil is withdrawn by means of the front cock, air being let into the cylinder at the same time by the removal of the rear plug.

† The buffer will be kept on the platform filled with the proper quantity of oil, and when not required for immediate use the piston rod will be disconnected from the carriage and pressed home into the cylinder.

A zinc pan to catch any dripping of oil from the gland in firing is suspended in front of the buffer.

A common spanner, for use in loosening or tightening the packing gland of the buffer, will be issued in the proportion of one per work or battery; a double-headed spanner for the purpose of removing the screw plug, and turning or tightening the cock, is supplied with each buffer, and McMahon's spanner is used for screwing and unscrewing the nuts and collars.

RACERS.

The racers for guns under 10-inch are of wrought iron, and of the same section, viz., $2\frac{1}{4}$ inches deep by $2\frac{7}{8}$ inches wide, and with a flange $\frac{3}{4}$ inch deep at the bottom at each side.

The radii of the racers are as follows:—

Pivot.					Front. ft. in.	Rear. ft. in.
A	..	..	..	..	6 3	16 6
A	(Elswick pattern, casemate)				5 $5\frac{1}{2}$	16 6
C	(centre)	..	..	..	5 $5\frac{3}{4}$	5 $5\frac{3}{4}$
D	..	..	..	..	9 0	2 $3\frac{3}{4}$

* These holes were formerly 1 inch; pistons having these sized holes should have one plugged up.

† It should be removed from platforms of guns seldom used, emptied, and kept in store.

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R.M.L. Ordnance (7-inch).

PRESERVATION OF SIGHTS, FITTINGS, &c.

I.—Fittings, &c.

The parts liable to damage by exposure, viz. :—

The elevating arcs and pinions,

The front and rear carriage rollers, with connecting shaft, should be removed from all guns and carriages, also such exposed parts of traversing gear as are readily shifted, except one or more (at the discretion of the Commanding Officer) which may be held in readiness for action.

When the position of the guns is such that no inconvenience is likely to accrue from some delay in preparing them for action, the screws, adjusting and compressor, with levers, &c., may be kept in the Artillery store until wanted for use.

The compressor gear should, however, be temporarily applied to the carriages as often as is necessary, to satisfy the Commanding Officer of the completeness and good working order of every part.

The axles of the platform trucks should be occasionally oiled.

II.—Sights.

Where guns are mounted in exposed positions the whole of the sights should be removed, and kept in store, the holes in the guns being filled with a plug of greased tow to keep out the rain and dirt. These plugs can be readily removed when it is required to fit the sights to the guns, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses.

The set-screw for clamping the centre-hind sight, not being removable from the gun, should be tested to see that it works freely.

The sights themselves should be kept clean, free from grit, and oiled; the sliding leaf and elevating nut* of the tangent scales, as well as the collars of the centre-fore and trunnion sights, should have free play.

The exposed portions of the sights are bronzed if made of gun-metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or blueing.

III.—Plates, Metal, Elevating.

These plates are removed for transport, and the holes in the gun fitted with preserving screws.

IV.—Preserving Screws.

Guns fitted for land service have the friction tube pin holes and the guide plate hole filled by preserving screws, and it is advisable that these screws should be occasionally removed and oiled to prevent their becoming fixed by rust.

* These are on the sights issued prior to 12/12/71.

R.M.L. Ordnance (7-inch).

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DRILL WITH 7-INCH R.M.L. GUN ON TRAVERSING PLATFORM.

The detachment consists of 10 Nos., and falls in two deep.

TO TELL OFF.

<i>Officer.</i>		<i>No. 1.</i>
<u> </u>		<u> </u>
<i>Tell off.</i>		

At "Tell off" No. 1 (who is on the left of the detachment) takes a pace to his front, turns to his right, and numbers himself 1; the right-hand man of the rear rank numbers 2; the right-hand man front rank, 3; the second man from the right of the rear rank, 4; the man in his front, 5, and so on. After the detachment is told off, No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery and halted in line facing the parapet, and to the left rear of the platform. The detachment is now in the position of "detachment rear."

TO TAKE POST UNDER COVER.

<i>Officer.</i>		<i>No. 1.</i>
<u> </u>		<u> </u>
<i>Take post under cover.</i>		<i>Right turn.</i>
		<i>Double march.</i>

The detachment stepping off, wheels to its left at the left corner of the platform, the front rank filing to the left of the gun, the rear rank to the right, 2 and 3 halting close to the parapet, and near the embrasure, 4 and 5 forming upon their right and left, and the whole turning to the right-about together. No. 1 follows in the rear of the detachment, keeping under cover as much as possible; 6 and 8 go to the cartridge store (6 outside), 7, 9, and 10 to the shell store (7 and 9 outside).

GENERAL DUTIES.

No. 1 commands, directs or superintends boring and fixing fuzes, and lays.

No. 2 searches, sponges, rams home, runs up and elevates.

No. 3 sponges, loads, uncaps the fuze when in the bore, rams home, runs up and elevates.

No. 4 attends to side arms, supplies them to 2, and traverses.

No. 5 attends to vent, supplies wedge wads, traverses, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes, brings up projectile.

No. 8 attends to cartridge store, serves out cartridges to 6.

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R.M.L. Ordnance (7-inch).

No. 9 assists 7.

No. 10 attends to shell store, issues shells, tubes and fuzes.

With Elswick compressor 4 attends to compressor lever.

If there are mantlets, 2 and 3 attend to them.

TO PREPARE FOR ACTION.

Officer.

Prepare for action.

No. 1.

*Prepare for action.
Examine gun.*

No. 1 provides and fixes sights.

No. 2, iron pointed lever, and assists 4 with side arms.

No. 3, iron pointed lever, elevating wheels, and removes the tampon from the muzzle.

No. 4, side arms.

No. 5, wedge wads, two iron shod levers, tubes in box, lanyard, pricker, and vent server.

No. 6, bucket, filled, and brush (one zinc cartridge cylinder and one dummy cartridge for drill purposes only).

No. 7, running back tackle, fuzes, fuze and shell implements, he obtains the fuze boxes from 10, satisfying himself as to the correctness of fuzes and fuze implements.

No. 8 goes to cartridge store and prepares to issue cartridges.

No. 9, running back tackle, a shell bearer and a brush.

No. 10 goes to shell store and prepares to issue shells, tubes, and fuzes, he examines the shells carefully, cleaning them if necessary, and removing burrs from studs; he loosens the fuze hole plugs of shells that will be first issued.

The stores having been brought up or found correct, No. 1 will satisfy himself that the foresights fit properly on the gun, the deflection leaves of the hind sights work easily, and that the clip plates are secured to the carriage; he ascertains that the hydraulic buffer is filled with the proper amount of oil, or the compressors properly adjusted and in working order. He sees that the racers are swept; he receives reports from the Nos. responsible of any irregularity or deficiency in connection with the different parts of the gun, carriage, platform, stores, ammunition, &c.

2 and 4 place the sponge and rammer in the supports on the right side of the platform, the shell extractor and wadhook in rear, so as not to interfere with the working of any of the guns in the battery, and convenient for those for which intended; 2 sees that the elevating gear, 4 that the traversing gear is oiled, and in good working order.

2 and 3 place the iron-pointed levers in their supports.

3 examines the bore to see the grooves are free from grit, &c.

5 straps the tube box round his waist on the right side, coils up the lanyard, and passes the bight of it under the tube box

R.M.L. Ordnance (7-inch).

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strap, fills his box with friction tubes, which he procures from 10, places the iron shod levers on the ground parallel to and either side of the gun, places the pricker in the loop on the side of the carriage; examines the vent server and places it in the vent, the loop of the vent server lanyard over one of the sights.

6 supplies the trough (for reception of the sponge head) with water from the bucket, and places the latter clear of the working of the gun.

7 and 9 hook the double blocks to the rear eyebolt of the platform, round in the tackle, and coil down the fall.

"*Examine gun*," No. 5 drifts the vent, replaces the pricker in the loop and the vent server; 2 searches the gun after the pricker is withdrawn, supplying himself with the wadhook and replacing it.

4 and 5 elevate until No. 1 gives "*Halt*," which he does when the gun is in a convenient position for sponging and loading; the whole of the numbers take post under cover.

When levers are used for elevating, 4 and 5 will clamp at "*Halt*."

TO LOAD.

<i>Officer.</i>	<i>No. 1.</i>
Range—yards.	With—load.
With—load.	

"*Load*."

No. 1 gives 7 the nature of shell and length of fuze required, and adjusts the tangent sight.

No. 2 moves into position for sponging, receives the sponge from 4, and, assisted by 3, sponges as soon as the vent server is in the vent; he then returns the sponge to 4 and receives the rammer; as soon as the cartridge and projectile are in the bore he rams home assisted by 3; he springs the rammer, assisted by 3, and retains it in his hand while the wedge wad is being put in; 2 and 3 press it steadily home, jamming it under the head of the projectile with two smart taps, the rammer is sprung as before, and 2 returns it to 4; should it appear by the mark on the rammer that the charge is not home, 2 and 3 ram home again, before the wedge wad is introduced.

No. 3 moves into position and, having assisted 2 to sponge, slews to his right, draws the cartridge from the cylinder with his left hand, choke to his left, and places it in the bore. When the projectile is in the bore he pushes it well in (uncaps the fuze, if required), and assists 2 to ram home and spring the rammer; he receives a wedge wad from 5, places it in the bore and assists 2 to press it home and spring the rammer.

No. 4 hands the sponge to 2 and replaces it. He supplies the rammer as soon as the projectile is in the bore and replaces it. He cleans and damps the sponge.

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No. 5 provides 3 with a wedge wad.

No. 6 supplies a cartridge to 3, bringing it up on his shoulder, standing at his right rear and keeping the cylinder closed till the sponge is out of the bore; 7 and 9 bring up the projectile, place it in the bore; 9 removes the empty bearer; 8 issues a cartridge to 6; 10 issues a shell to 9.

The projectiles are to be placed in the bearer so that the rear studs are in line with the end of it; the handles of the bearer being turned down whilst the projectile is placed in it.

TO RUN UP.

<i>Officer.</i>	<i>No. 1.</i>
<hr/>	<hr/>
	<i>Run up.</i>
	<i>Halt.</i>

"Run up," 2 and 3 put the iron pointed levers into the sockets and bear down; should it be observed that the gun is running up too rapidly 2 and 3 raise their levers and check it.

When the gun is in position No. 1 gives the word "*Halt*;" 2 and 3 raise their levers till the sockets are touching the stop plates. They then replace them. No. 5 hooks a tube to the lanyard; 2 and 3 close the mantlets.

TO LAY THE GUN. (See SECTION IV. page 336.)

<i>Officer.</i>	<i>No. 1.</i>
<hr/>	<hr/>
	<i>Elevate. Halt.</i>
	<i>Depress. Halt.</i>
	<i>Trail right. Halt.</i>
	<i>Trail left. Halt.</i>

2 and 3 work the elevating, 4 and 5 the traversing gear.

If the rear trucks are fitted to receive the iron pointed levers 4 and 5 apply them; if not so fitted iron-shod levers or tackles must be used, 6 and 7 assisting, if necessary.

Should no order to fire be given when the gun is laid, No. 1 will give the word "Under cover."

TO MAKE READY AND FIRE.

<i>Officer.</i>	<i>No. 1.</i>
<hr/>	<hr/>
<i>Fire — rounds.</i>	<i>No. — ready.</i>
	<i>No. — fire..</i>

R.M.L. Ordnance (7-inch).

Section I.

At "*Ready*" the gun numbers stand clear. No. 5 places the tube in the vent, descends from the platform, passes the lanyard through the rear eye bolt of the carriage, and stands ready to fire facing the gun. At "*Fire*" he draws the lanyard strongly towards him without a jerk, he drifts the vent, replaces the vent server and pricker and coils up the lanyard, placing it under his belt.

When platforms are fitted with traversing gear, 4 and 5 will, after the gun has been fired, traverse it back to a position convenient for loading, without any word of command.

TO RUN BACK AND UNLOAD.

<u>Officer.</u>	<u>No. 1.</u>
	<i>Run back. Halt.</i>
	<i>Unload.</i>

At "*Run back*" No. 1 follows up the right front truck with a scotch; 2 and 3 apply their levers and bear down; 4 and 5 overhaul the tackle and hook the treble blocks to the front eye-bolt of the carriage. The tackles are manned by all the available numbers on their own sides. At "*Halt*" 2 and 3 raise their levers and replace them.

When the gun is back, 4 and 5 unhook the front blocks and lay them down after overhauling the tackle. The gun is unloaded by the numbers who loaded it.

TO CEASE FIRING AND REPLACE STORES.

<u>Officer.</u>	<u>No. 1.</u>
<i>Cease firing.</i>	<i>Depress. Halt.</i>
<i>Replace stores.</i>	<i>Replace stores.</i>

The gun is depressed, and the stores are replaced by the numbers who brought them up.

TO FORM DETACHMENT REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Outwards turn.</i>
	<i>Double march.</i>
	<i>Halt.</i>
	<i>Front.</i>

Section I.

R.M.L. Ordnance (7-inch).

"*Detachment rear.*"—No. 1 doubles to the left rear of the platform, faces to the left, and gives the order "*Outwards turn,*" 2 and 4 turn to their left, 3 and 5 to their right.

"*Double march.*"—4 and 5, followed by 2 and 3, wheel to the right and left, and when clear of the platform to the right, and round No. 1's left shoulder, 6, 7, 8, 9, and 10, coming up into their places; when 2 and 3 have passed him No. 1 gives "*Halt,*" "*Front,*" and changes his flank by the rear.

TO CHANGE ROUNDS.

<u>Officer.</u>		<u>No. 1.</u>
<i>Change rounds.</i>	|	<i>Change rounds.</i>

No. 2 becomes 4, 4 1, 1 10, 10 9, 9 8, 8 7, 7 6, 6 5, 5 3, 3 2.

7-INCH ON MONCRIEFF CARRIAGE.

MONCRIEFF CARRIAGES AND THEIR PLATFORMS.

The principles upon which Major Moncrieff has constructed his garrison carriages may be said to be twofold, namely:—

First. To afford cover to the gun detachment by enabling the gun when run up to fire over a solid parapet, though when run back to be in a low and convenient position for loading, and entirely protected from view and from direct fire.

Second. To store up the force of recoil and utilize it for bringing the gun from the loading to the firing position.

In general terms we may say that Major Moncrieff carries out these principles by using a level traversing platform, and placing the gun, and its carriage proper, in a carriage termed an "elevator," which rolls upon the platform, and which in so doing, from its peculiar form, places the gun in the required position either for loading or firing. Further, he weights the opposite end of the elevator to that in which the gun lies, so that as the force of recoil causes the elevator to roll to the rear and the gun to descend, it at the same time raises the weight. The latter being thus placed in an elevated position has a certain amount of energy stored up, as it were, in it, which energy, as soon as the weight is permitted to fall, is expended in raising the gun to the firing position again, the elevator rolling to the front.

R.M.L. Ordnance (7-inch).

Section I.

In fact the elevator may be regarded as a lever of the first order, the gun at one extremity and the weight at the other; and here it is to be noticed, first, that the fulcrum on which the elevator rests is not fixed, but movable or changing, whereby any jar or concussion to the parts on discharge is avoided, at least in a horizontal direction; second, still further to insure against any such jar, the curve of the rolling surface of the elevator is such that on discharge and during first motion, the latter moves freely, the counterweight not taking up much of the force of recoil. In fact, the elevator rolls about half the length of the platform before the leverage of the counterweight or resistance increases much. For the remainder of the length of the platform the curve is such that the counterweight acts with a rapidly-increasing leverage, while that of the gun or force of recoil diminishes, so that the latter is more and more absorbed until finally the gun comes to rest.

"That there may be no dead point or tendency to run back in some positions, if checked, in rising from the loading to the firing position, as is necessary to prevent the mass running up violently, the apparently quadrantal part of the elevator is in reality an arc of the involute of a small circle described round the common centre of gravity of the gun carriage and elevator, or rather round the projection of that centre on each side of the elevator."

There are two patterns of Moncrieff carriages; in the first the gun is placed in a carriage distinct from the elevator, in the second the elevator itself carries the gun.

TABLE.

Nature.	Mark.	Weight.*			Ton- nage.	Height of Axis of Trunnions.	
		Part.	tons.	cwt.	qrs.	Firing position.	Loading position.
7-in. M.L.R. of 7 tons	I.	Carriage	1	14	0	†11 0	7 1
		Elevator	14	17	0		
		Platform	5	12	2		
" " "	II.	Elevator	—	—	—	†12 3½	5 8
		Platform	—	—	—		
7-in. B.L.R. of 82 cwt.	II.	Elevator	8	19	2	10 5½	5 1½
		Platform	4	3	1		
64-pr. M.L.R. of 58 cwt.	II.	Elevator	8	1	2	10 5	4 9½
		Platform	3	15	2		
9-in. M.L.R. of 12 tons	II.	Elevator	26	7	0	14 0	6 11½
		Platform	13	1	0		

* With gear. † To fire over a parapet 9½ or 10' high. ‡ To fire over a parapet 11' high.

7-INCH M.L.R. OF 7 TONS CARRIAGE. MARK I.

THE CARRIAGE PROPER.

The carriage A is formed of two brackets connected by two transoms.

The brackets are nearly triangular in shape, and are each composed of a wrought-iron frame $3\frac{1}{2}$ inches wide, with a $\frac{1}{4}$ -inch plate riveted on either side. In the upper part is the trunnion hole fitted with a metal bearing plate and a capsquare secured by clips with screws and bolts; in the lower part to the front is a metal-bouched hole to receive the shaft which connects the carriage to the elevator, while in the rear a wrought-iron axle is secured. The latter passes from one bracket to the other, and has near its extremity, outside each bracket, a wrought-iron truck with securing collar. The axle has a piece of angle iron bolted along its upper surface and another piece along its under side; it is secured to each bracket by two knees and a stay.

The transoms are of plate connected by means of angle iron to the brackets; the front is placed vertically, the rear horizontally.

The second or rear transom supports the elevating arrangement, which consists of the following parts, namely:—

One shaft.

Two pinions.

Two elevating arcs.

Two clips.

Two nuts.

One worm wheel, comprising two friction cones and one metal band with teeth.

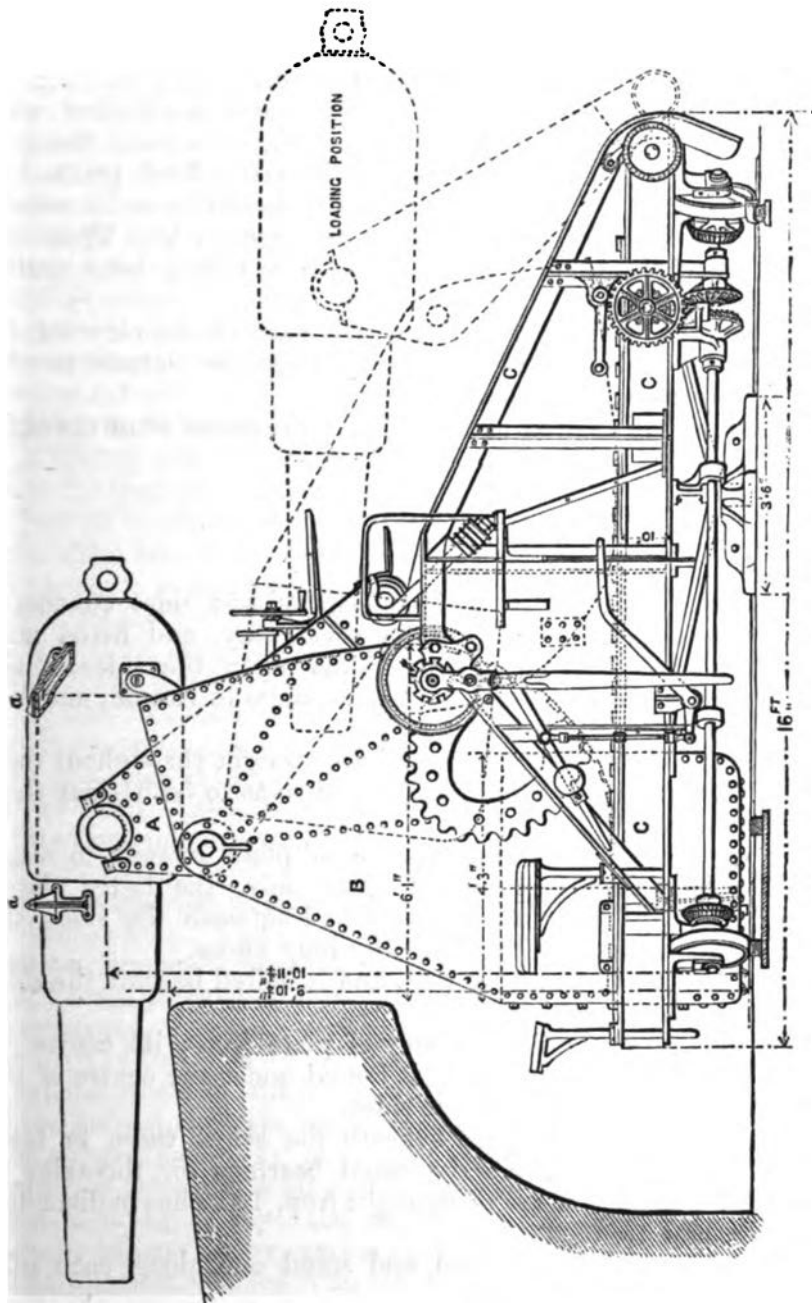
One worm shaft with two hand wheels and a locking handle.

The elevating arcs are pivoted to the gun in the usual manner, and the right-hand arc is graduated with degrees, a pointer being fixed upon the bracket by which to set it.

The elevating shaft rests in metal bearings in the brackets and in a third bearing bolted to the transom. The pinions upon this shaft gear in the elevating arcs, the latter being kept in position by the clips. On the right hand of the shaft is the worm wheel, which is worked by the worm shaft, the latter being supported in metal bearings, one on the front transom and two on the rear transom.

To allow of some slip (about 20) of the arcs on firing, the worm wheel is made composite, in a similar manner to that in Mark II., to be hereafter described. The locking handle is placed upon the rear of the worm shaft; turning it presses a nut against a collar on the shaft and prevents the latter moving, and consequently the worm wheel, on firing.

A laying stage is attached to the rear transom, and a step to mount to it to the rear of each bracket.



THE ELEVATOR.

The elevator B, consists of two sides connected at the lower part by wrought-iron boxes, which contain the counterweight, and at the upper part by a transom.

The sides are formed in the same manner as the brackets of the carriage; their rear edges or surfaces are curved, and have teeth formed on them to guide the elevator in its rolling upon the

Section I.

R.M.L. Ordnance (7-inch).

platform and to prevent slip. The counterweight boxes (three, two sides and one centre) are bolted between the sides in such a manner that when the gun is raised to the firing position they lie between the sides of the platform. These boxes are packed with pieces of cast iron and wood of sufficient weight to raise the gun from the loading to the firing position without a dead point. In the upper part of the elevator are metal-bouched holes to receive the main shaft which connects the carriage to it. Upon the extremities of the shaft outside each bracket is a loop washer secured by a screw.

A cycloidal rack is bolted to each side of the elevator for pinions on the platform to gear into, by which the elevator can by hand be moved to any position.

A shot guide is bolted upon the lid of the centre counterweight box to facilitate loading.

THE PLATFORM.

The frame of the platform C, consists of two sides connected by four transoms, a cross stay and a pivot stay, and fitted with flat-soled trucks in flanged feet. Fixed upon the sides of the frame are guides for the trucks of the carriage to run on, and also walls to support brake gear, &c.

The sides are of girder iron, and are straight throughout their length; they are 16 feet long, and placed so as to be $5\frac{1}{2}$ feet from outside to outside.

The second and third transoms are of plate riveted to angle iron; the front and rear are of plate only, the latter placed horizontally; all four transoms are bolted between the sides, the first and second being strengthened by long knees.

The cross stay is of girder iron, and is bolted beneath the sides $9\frac{1}{2}$ feet from the front.

The pivot stay is a diagonal stay of plate iron; its centre, to which a pivot socket is attached, is bolted under the centre of the cross stay and its arms under the sides.

The flanged feet are bolted beneath the sides, those in front projecting outwards; two have metal bearings for the axles of the trucks. The latter are of wrought iron, 16 inches in diameter, and their axles are of steel.

The guides are of angle iron, and stand one along each side, supported by stays of T iron.

The walls are of plate, each in the form of a box, open at the top and the bottom, extending from the top of the highest part of the guide to the lower edge of the side. They are riveted to four of the stays of the sides, and are supported also by a piece of "T" iron fixed across and under the platform.

A guide rack to guide the elevator in its motion is fixed along the upper surface of each side; it has teeth in it corresponding to those in the elevator, and a stop at each end.

R.M.L. Ordnance (7-inch).

Section I.

When the weighted lever of the break gear is observed to be nearly touching the bottom of the slot through which it works, it is a sign that it is coming by wear into a position in which it cannot act; the lever should then either be reset or the wood of the break band renewed.

Brake gear, for the purpose of holding the elevator down after recoil and controlling its rise, is fitted on each side of the platform. It consists, on each side, of a shaft supported in metal bearings on the upper part of the wall; on the inner end of the shaft there is a pinion gearing in the cycloidal rack of the elevator, on the centre a brake wheel, towards the outer end a ratchet wheel, and on the outer extremity a socket to receive an iron-pointed lever. *The brake wheel with the gear connected with it is similar to that of Mark II., to be presently described.

A sliding locking plate is bolted on the front of each wall to secure the gun when left standing in the loading position: to use the bolt its retaining screw is withdrawn and it is allowed to drop on the short arm of the bent lever, in which position it is secured by its screw; it acts by preventing the arm rising and the friction band being thereby loosened.

A loading stage on two supporting bars is fitted across the breast of the platform, and two others, one on each side, near it, for the numbers loading the gun; the latter are pivoted each on a single supporting bar, so that they can swing clear of the elevator as the gun rises to the firing position.

Two other stages, with guard irons and ladders to ascend by, are fitted one on each wall of the platform.

A preventor hook with india-rubber washers, separated by plates, is supported in a cast-iron socket bolted to the top of the rear of each wall. The hooks catch the points of the axletree arms of the carriage and arrest the latter when run up.

A bollard is fitted on each side of the platform in rear, to take, on emergency, a preventor rope led from the loop washer on the main shaft of the elevator. On the inner side of the bollard there is a ratchet wheel in which a pawl, pivoted on the guide, drops, so that the bollard can only turn in one direction.

A pointer, consisting of a small plate of steel which fits over the racer, is attached by an arm to the flange of the left rear truck, so that in firing at any fixed object the correct line of fire can readily be adhered to by marking the racer.

The platform is fitted with traversing gear, as follows:—

A long and a short shaft are held in cast-iron brackets under the left of the platform; they lie in prolongation of each other and at an angle to the side. On the front extremity of the long shaft there is a bevel pinion (14 teeth) gearing into a bevel wheel (18 teeth) on the spindle of the front truck: on the rear extremity

* These wheels are not interchangeable from one side of the platform to the other, and are therefore marked "R" and "L."

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R.M.L. Ordnance (7-inch).

of the short shaft there is a similar pinion gearing into a bevel wheel (26 teeth) on the rear truck; upon the other extremities of these shafts there are mitre wheels (30 teeth) facing each other. Gearing into these latter is a mitre pinion (15 teeth) on a short vertical shaft placed between them. Upon the upper extremity of this vertical shaft there is a second mitre pinion (15 teeth), which is driven by another pinion on a cross shaft. The latter passes through the sides of the platform, and has upon each extremity a spur wheel which is driven by a pinion and winch handle. The spur wheels and pinions are covered by guards, and also the pinion gearing into the front truck wheel.

PAINTING.

The interior of the counterweight boxes and of the brake drums receive two coats of red lead; with this exception, and bearing surfaces, &c., which are not painted, the carriage, elevator, and platform receive two coats of lead paint, grey colour.

MOUNTING.

The platform with its gear and trucks attached is first lifted into its place, the pivot and socket being previously greased.

The elevator is next placed upon the platform, care being taken that the proper teeth are in gear; blocks of wood are placed temporarily under the counterweight boxes and across the platform, so that the lids of the former are held nearly horizontal.

The carriage is then secured in position, the shaft being first cleaned and oiled.

The gun is mounted, its breech supported by a block of wood.

The counterweight boxes are packed, and finally the gear, &c. fitted on.

7-INCH R.M.L. OF 7 TONS CARRIAGE. MARK II.

THE ELEVATOR.

In this pattern the elevator is constructed of two double-plate sides (as in Mark I.), the frames of which, of wrought-iron, are $2\frac{1}{2}$ inches wide, and the plates $\frac{3}{8}$ inch thick. These are connected at the lower part by the counterweight, which is secured between them by bolts, and consists of solid blocks of cast-iron. In the upper part of the sides trunnion holes are formed and fitted with capsquares which slide into position and are secured by screws. An eyebolt to take a preventor rope on emergency is screwed into each trunnion of the gun, and as there is no transom between the sides of the elevator, the gun itself is made to serve as one by placing a large washer on the trunnion secured by the eyebolt.

R.M.L. Ordnance (7-inch).

Section I.

There are no cycloidal racks for pinions on the elevator for the purpose of retaining or controlling the recoil, but instead there are what are termed "retaining racks" on the platform, to which the elevator is connected by connecting bars. One end of each of the latter is metal-bouched, and pivots on a spindle passing through part of the counterweight and the side of the elevator.

To carry the breech of the gun and also give the required elevation in laying, a long elevating bar A, Fig. 1, Plate II., is attached to a metal patch under the breech by a bolt, which also supports a laying stage; the lower extremity of this bar is pivoted between two radius bars B, B, one end of each of which is bent outwards and attached to a spindle in the side of the elevator, while their other extremities hold a metal roller between them. This roller runs in an elevating guide on the platform, to which the required degree of elevation is given and communicated by the elevating bar to the gun. On recoil the roller of the radius bars travels to the rear along its guide, while the elevating bar changes from a vertical to nearly a horizontal position.

THE PLATFORM.

The sides of the platform are 17 feet long and placed 4 feet $9\frac{1}{2}$ inches apart, from outside to outside; they are built up of two bars of channel iron, 1 foot 2 inches in depth, along which, above and below, 1-inch plate iron is riveted.

Three transoms connect the sides; each is formed of plate riveted between frames of angle iron; in the front and rear transoms the frames extend all round the plate, but in the centre transom only along the sides and lower edge. The latter transom extends a little below the lower surface of the sides and not as far as the upper surface. In addition to the transoms connecting the sides there is underneath them a trough-shaped cross stay, through the bottom of which the pivot bolt passes, 10 feet $9\frac{1}{2}$ inches from the front; this stay is strengthened by a band of plate iron passed under each end and bolted under the sides.

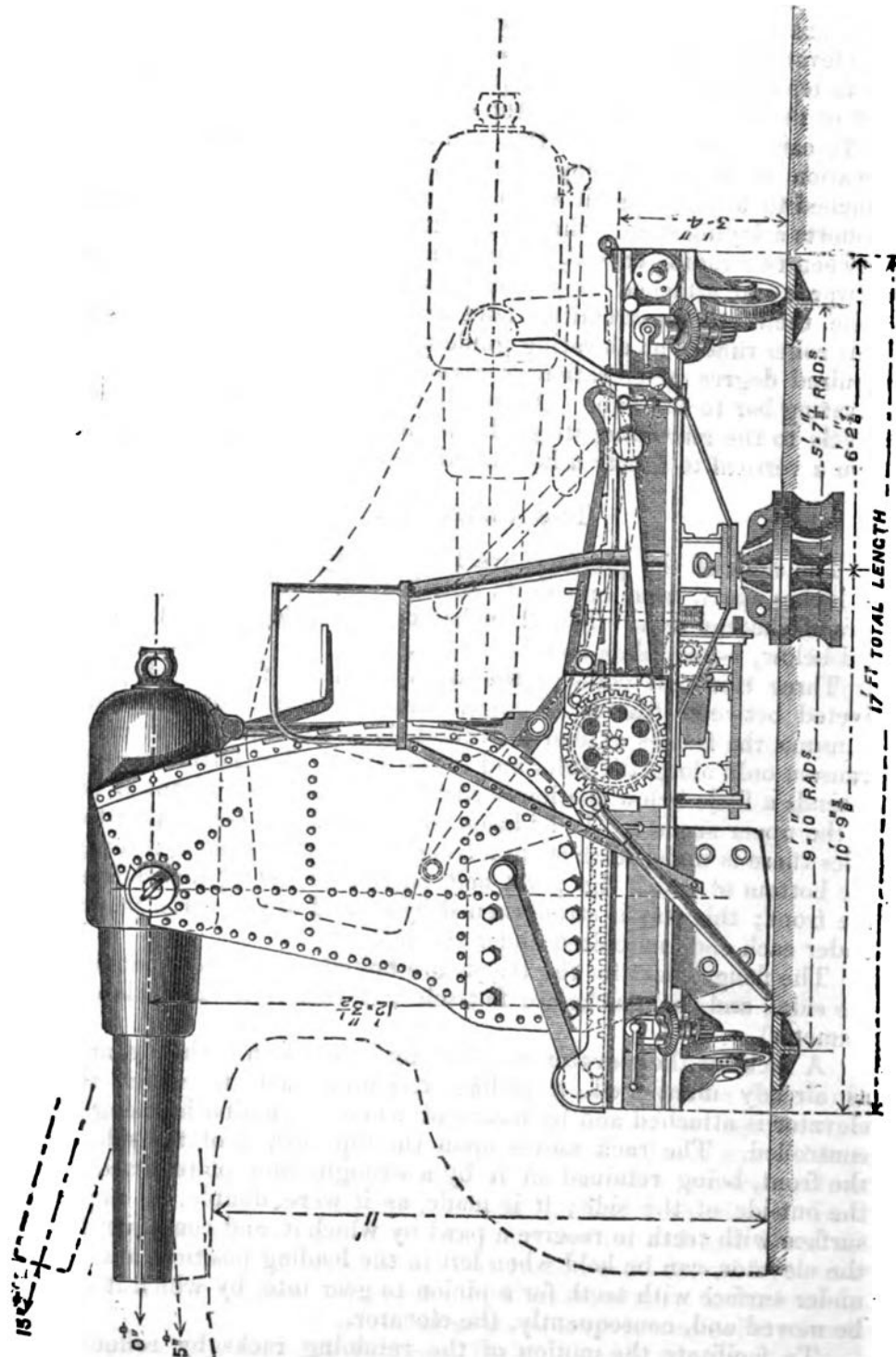
The flanged feet for the trucks are bolted immediately beneath the sides, and the trucks are flat-soled, of cast iron (21 inches in diameter).

A rack for the elevator to roll along is fitted on each side, and, as already mentioned, a sliding retaining rack to which the elevator is attached and by means of which its motion in rising is controlled. The rack moves upon the top surface of the side to the front, being retained on it by a wrought-iron plate fitted to the outside of the side; it is made, as it were, double, its upper surface with teeth to receive a pawl by which it, and consequently the elevator, can be held when left in the loading position, and its under surface with teeth for a pinion to gear into, by which it can be moved and, consequently, the elevator.

To facilitate the motion of the retaining racks by reducing friction, four metal rollers are fitted on the front of each rack as well

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R.M.L. Ordnance (7-inch).



R.M.L. Ordnance (7-inch).

Section I.

as a scraper to push off any sand, &c., that might fall on the platform in front of the rollers. The pinions by which the retaining racks are worked are placed upon a cross shaft which passes through the sides of the platform, and which is fitted with brake wheels, one on each side outside the platform, by means of which the elevator is held down after the force of recoil has ceased, and by which the rise of the gun again to the firing position is kept under control. A brake wheel consists, Fig. 2, Plate II., of a cast-iron band (in Mark I. of metal) *a*, containing a cast-iron ratchet wheel *b*, which can move independently of the band, but must move with the cross shaft. Four pawls *d, d*, for the ratchet wheel, are pivoted to the band, so as to act as if they were of different lengths, and are each kept from falling back too far by a spring. The ratchet wheel with its pawls are enclosed between two wrought-iron plates *e, e*, let into and bolted one on each side of the band.

Round the brake wheel passes a friction band of iron lined with wood, one end of which is fixed to the side of the platform and the other to a bent lever. The latter is pivoted to the platform near its bent end, while the other arm, which lies along the platform towards the rear, is weighted with a cast-iron sliding weight secured by a screw. The weight is so adjusted as to tighten the friction band sufficiently to hold the brake wheel, so that the pawls of the latter may prevent the ratchet wheel turning back and the elevator rising as soon as the force of recoil has ceased. When the weighted arm of the lever is raised, and the friction band thus loosened, the whole of the brake wheel is allowed to revolve, and therefore the elevator to rise. In order that the brakes on each side of the platform may be worked simultaneously, a cross shaft is fitted through the sides of the platform to the rear, to each end of which a bent lever is attached. The counter-lever of the latter is connected by a small shaft, which has an adjusting screw on each end, with the weighted lever of the friction band. Pulling the end of the bent lever to the rear raises the weighted lever and loosens the band, and not only on the side of the bent lever used, but also, by means of the cross shaft, on the other side also, if the adjusting screws are properly set.

A ratchet wheel *f*, Fig. 2, is fitted on the brake shaft outside each brake wheel, and a movable socket with pawl for the purpose of moving the elevator by hand into any required position. The pawl is double, so that it will act either way; when in gear with the ratchet wheel and the socket is worked by an iron-pointed lever, the shaft is turned and its pinion moves the elevator.

The brake drums and the pinions are covered by guards.

The elevating guide *D*, Fig. 1, Plate II., to receive the roller *N* of the radius bars lies along the centre of the platform to the rear, being pivoted on a support which rests upon a piece of T-iron fitted across the platform.

To give the elevation required in laying the gun, an elevating arc *E* is attached beneath the front of the guide, and passes down

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R.M.L. Ordnance (7-inch).

between a friction roller F and pinion G, by the latter of which it is worked. These are supported between two plates H fitted beneath the platform from the front of the cross stay to a piece of girder iron I riveted under the centre transom. The pinion is upon the inner end of a short shaft M, the other end of which passes through the right side of the platform, and has upon it a worm wheel K, which is worked by a worm shaft L, fixed vertically on the side, and turned by a hand wheel. The worm wheel, in order to allow of some slip of the elevating arc on firing, and so reduce the shock on the parts, is made composite (as in Mark I.); it consists of two frustra O, O, Fig. 1, of a cone, placed top to top (not touching), and turning with the shaft M; over these the worm wheel proper is placed in the form of a band P. By this arrangement, when the frustra are pressed towards each other the band is tightened upon them, and *vice versa*. The tighter the band is made the less will be its slip, and consequently that of the elevating arc. The frustra are pressed together, as desired, by means of a nut Q, outside of which a locking nut R is placed.

A loading stage is formed between the sides at the centre by baulks supported on angle-iron frames. In this pattern the operation of loading is much easier than in the first pattern, being performed under instead of over the counterweight. The projectile being placed upon the loading stage, is hoisted to the muzzle by means of a chain over a block attached to the counterweight, and led by a leading block on the side of the elevator and another on the stage to the outside of the platform.

A stage with ladder is fixed on the left side of the platform, which is also fitted with bollards similar to those in Mark I.

Traversing gear is fitted to the platform, to the left front, and to the left rear trucks, independent of each other. It consists for each truck of a bevel wheel on the truck worked by a bevel pinion on a very short shaft, which is held in a bracket bolted on the outside of the side. The shaft has a bevel wheel on its upper extremity, into which a pinion moved by a winch handle gears.

DRILL WITH 7-INCH R.M.L. GUN ON MONCRIEFF CARRIAGE. MARKS I. AND II.

The detachment, consisting of ten numbers, is told off and takes post under cover as with the same gun mounted on a traversing platform.

R.M.L. Ordnance (7-inch).

Section I.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, attends to the brake in running up, and lays.

No. 2 searches, sponges, places projectile in bore, rams home, (attends to lever if required,) and elevates.

No. 3 sponges, loads, uncaps fuze when in the bore, rams home (attends to lever if required).

No. 4 attends to side-arms, supplies them to 2, traverses (attends to lever if required).

No. 5 attends to vent, depresses the gun for loading, supplies wedge wads, elevates previous to running up (about 1°), traverses (attends to lever if required), makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes, brings up the projectile, and places it on the front loading stage.

No. 8 attends to cartridge store, serves out cartridges to 6.

No. 9 assists 7.

No. 10 attends to shell store, issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

As with the gun on a traversing platform, except no preventor rope or iron shod levers are required; No. 5 provides a long lanyard.

2 and 3 bring up an iron pointed lever each, which they lay down on each side of the gun.

Tackle will be necessary to run the gun back. Two sets of heavy gun tackle are brought up by 7 and 9.

The sponge and rammer are laid down on the right of the gun, close to the parapet, heads towards the muzzle, the shell extractor and wad hook outside the pit.

At "*Examine gun*," same as at 7-inch R.M.L. on a traversing platform, except 4 supplies 2 with the wad hook, and replaces it, and 5 attends to the elevating wheel and depresses, after the gun has been searched, until the muzzle rests on the elevator.

TO LOAD

As with the gun on a traversing platform, except as follows:—

No. 1 at "*Load*" gets the gun into a convenient position, i.e., the upper edge of counterweight nearly horizontal, 5 depresses the gun if necessary; 2 and 3, in mounting up, give the small loading stages a quarter turn inwards, and stand on them with their inward feet, the outward feet of both numbers being on the front loading stage; after the cartridge has been placed in the bore, they raise the projectile in its bearer to the guide block in front of the muzzle.

(A. M.)

Q

Section I.

R.M.L. Ordnance (7-inch).

After the loading is completed, they turn the loading stages outwards. 5 gives 1° or more of elevation, as shown on the arc.

TO RUN UP.

Before running up, No. 1 will give the caution, "*Stand clear;*" then holding the brake he allows the gun to run up.

He must be very careful not to let it escape from his control, and on the other hand he must not check it too soon. Should the latter be the case, No. 1 gives "*Work levers,*" 2 and 3 fix the latches and work their levers, small ends to the rear; 2 and 4 man the right, 3 and 5 the left lever; No. 1 will give "*Down,*" "*Fresh purchase,*" "*Halt,*" as required.

When the gun is up, No. 1 will mount up the ladder to lay it, 2 and 3 slackening the latches and unshipping the levers; 4 and 5 man the traversing handle.

TO LAY THE GUN.

4 and 5 traverse.

2 elevates or depresses.

The gun may be laid without exposing any number; No. 1 using a reflecting sight, or elevating in accordance with the graduations on the elevating arc or trunnion pointer, and traversing to marks previously made on the racers.

TO MAKE READY AND FIRE.

When No. 1 has laid the gun, at "*Ready*" 5 mounts up and drops the tube into the vent, throwing the lanyard clear of the carriage, and comes down.

When the gun is laid from below, No. 5 makes ready before the gun is run up. As soon as he has fired he drifts the vent, replacing the vent server and pricker, and coiling up the lanyard.

TO UNLOAD AND RUN BACK.

(For drill purposes extra men will be required.)

To run back, 2 and 3 fix the latches, and work their levers, small ends to the front, and bear down, double-manned by 4 and 5. No. 1 giving "*Down,*" "*Fresh purchase,*" "*Halt,*" as required. Tackle to be hooked by 7 and 9, assisted by 6 and 8, and manned by all available numbers.

Unloading should be effected from the firing position before the gun is run back.

TO CEASE FIRING AND REPLACE STORES.

TO FORM DETACHMENT REAR.

TO CHANGE ROUNDS.

As with the same gun mounted on a traversing platform.

R.M.L. Ordnance (9-inch).

Section I.

9-INCH R.M.L. GUN OF 12 TONS.

DESCRIPTION.

	Mark I.	Mark II.	Mark III.	Mark IV.	Mark V.
Calibre ins.	9.0	9.0	9.0	9.0	9.0
Nominal weight .. tons	12	12	12	12	12
Preponderance .. cwts.	Nil.	5	5	5	3
Length { of bore	10 ft. 5 in.	10 ft. 5 in.	10 ft. 5 in.	10 ft. 5 in.	10 ft. 5 in.
of rifling	8 ft. 11.5 in.	8 ft. 8 in.*	8 ft. 8 in.	8 ft. 8 in.	8 ft. 8 in.
total	13 ft.	13 ft.	18 ft.	18 ft.	13 ft.
Rifling { grooves, number..	6	6	6	6	6
spiral increasing	From 0 at breech to 1 in 45 calibres at muzzle.				
Chamber	Cylindrical	Conical	Conical	Conical	Conical
"A" tube		Toughened steel.			
"B" tube		Coiled iron.			

DIFFERENT PATTERNS.

The different patterns of these guns are distinguished one from another in *external* appearance as follows:—

Mark I.	by being built up in 7 parts, including trunnion coil or ring.
Mark II.	„ 4 parts „
Mark III.	„ 3 parts „
Mark IV.	„ 4 parts „
Mark V.	„ 4 parts „

CONSTRUCTION.

Mark I. is of the "original construction," the later patterns of "the Fraser construction."

These guns are examined after every 50 rounds.

RIFLING.

The rifling is on "the Woolwich system," similar to that described for the 7-inch R.M.L. gun, with this difference, that the twist is "increasing."

VENTING.

The venting is similar to that of the 7-inch gun.

SIGHTING.

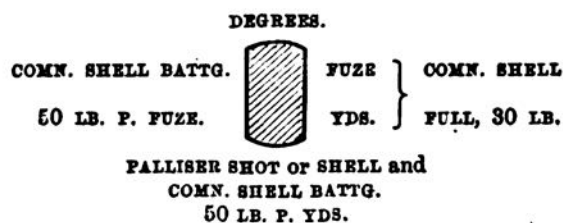
The gun is provided with six sights, viz.:—

Two tangent scales, one on each side, graduated up to 15°. The scale is four-sided, and is marked as follows:—

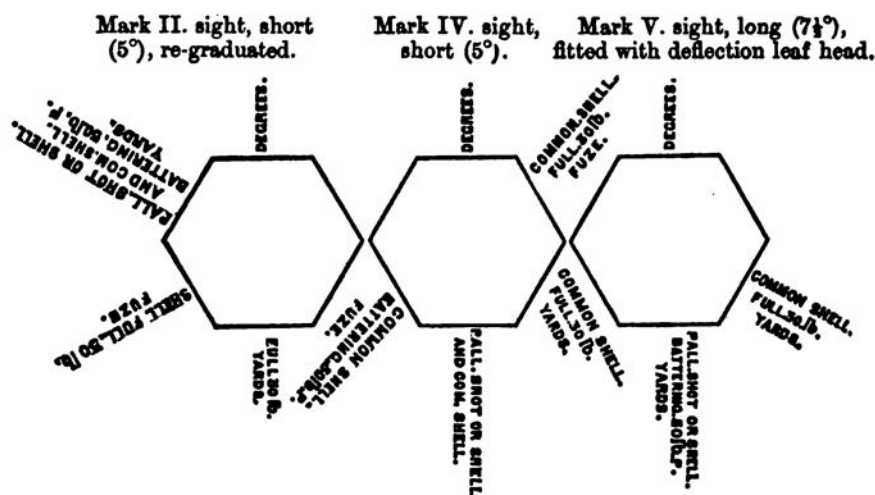
* Those made before January, 1868, have the same length of rifling as Mark I.
(A. M.) Q 2

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R.M.L. Ordnance (9-inch).



One centre hind sight. This is a scale for use at close quarters and moderate ranges. It works in a gun-metal socket fixed in the gun, and is provided with a set screw; is hexagonal, and marked as follows:—



Two trunnion sights. The sight consists of a pillar, collar, and socket of gun-metal, a steel leaf, and screw for fixing the leaf. The socket is permanently fixed in the gun; the pillar and collar each lock into it with a bayonet joint, so that when once the sight is in its true position, it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle to the left.

One centre fore sight. Similar to the trunnion sight.

PROJECTILES (WITHOUT GAS CHECKS).				Weight. lbs.
Shot	{	Case, filled with 118 8-oz. sand shot, clay and sand		107
		Palliser, cored { empty	244.75	
		with 3.75 lb. bursting charge ..	248.5	
Shells, Common*	{	empty	230.662	
		with 19 lb. bursting charge in bag	249.75	
Shells, Palliser ..	{	empty	242.875	
		with 5.5 lb. bursting charge in bag	248.437	
Shells, Shrapnel ..	{	filled with 374 2-oz. sand shot and		
		1 lb. 5 oz. bursting charge ..	255.5	
Gas checks, weight of.				

* Some of these shells will be found without unloading holes, which have now been discontinued in manufacture.

R.M.L. Ordnance (9-inch).**Section I.**

Case shot is used for close quarters against troops or boats.
 Palliser projectiles. Both shot and shell are used against iron-clads.

*Common shell is used against shipping.

CHARGES.

Battering 50 lb. P. or 43 lb. R.L.G. powder.
 Full 30 lb. L.G. powder.

9-INCH R.M.L. GUN.

Charge, 50 lbs. P. Projectile, with Gas-check, 258 lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1415	3734	133
500	1351	3268	166
1000	1266	2866.5	102.29
1500	1190	2532.7	90.38
2000	1123	2255.5	80.488
2500	1066	2032.4	72.52
3000	1020	1860.8	66.4

FUZES.

Time. 15 seconds M.L.O. for use with Shrapnel shell.

Percussion, Pettman, general service, for sea fronts, for use with common shell intended to burst on impact.

CARRIAGES.

TABLE OF WEIGHTS, &C., OF CARRIAGES FOR 9-INCH GUN OF 12 TONS.

Nature.	Weight.	Diameter of Rollers.	
		Front.	Rear.
	cwt. qrs.	in.	in.
9-inch R.M.L. single plate.. { casemate	37 0	12	8
{ dwarf	39 0	12	8
{ fitted for E.O.C. compressor	44 2	12	8
9-inch R.M.L. double plate { fitted for buffer and with O.P. elevating gear	40 0	..	..
{ fitted for buffer and with N.P. elevating gear	42 1	..	..
{ Elswick pattern, fitted for E.O.C. compressor .. ..	..	10	8
{ Elswick pattern, fitted for buffer	35 3	..	..

* If required, the common shell may be fired with battering charges.

Section I.

R.M.L. Ordnance (9-inch).

PLATFORMS.

TABLE OF WEIGHTS, &C., OF PLATFORMS FOR 9-INCH GUN
OF 12 TONS.

	Weight.	Width between sides.	Diameter of Trucks.	
			Front.	Rear.
	cwt. qrs.	ft. in.	in.	in.
9-inch R.M.L. platform for { casemate ..	57 3	2 10½	6	10½
single plate carriages { dwarf ..	74 0	2 10½	10½	15½
.. { casemate fitted for E.O.C. }	65 2*	3 6	8½	13
.. { compressor ..	69 2 (with	..	..	..
.. { ditto with buffer ..	gear)	..	..	..
9-inch { casemate, Elswick pattern ..	63 1	..	19½	13½
R.M.L. { dwarf "A" for E.O.C. com-	90 2*	..	18	24
platform { pressor ..	97 0 (with	..	..	..
for double { ditto with buffer ..	gear)	..	..	..
plate { dwarf "C" fitted with buffer	101 2	..	24	24
carriages { ditto "C" central ..	110 0	..	24	24
.. { dwarf "D" fitted with buffer	103 1	..	24	18

CONSTRUCTION OF CARRIAGES, PLATFORMS, &C.

The information contained on pages 211-216 and 252 applies equally to 9-inch gun. The worm wheel and worm elevating-gear for 9-inch gun differs from that described at page 252 in having an intermediate pinion. For traversing and running back gear (*vide* page 254).

GRADUATED ARC AND POINTER.

To indicate the angle of traverse a wrought-iron pointer is attached beneath the rear of platform, which points to a graduated arc let into the floor of the work. The graduations on this arc are numbered toward the right from 0° on the extreme left.

DRILL WITH 9-INCH R.M.L. GUN, IN CASEMATE
OR OPEN SHIELD BATTERY.

The detachment consists of 10 Nos. and falls in two deep.

TO TELL OFF.

Officer.

No. 1.

Tell off.

At "Tell off" No. 1 (who is on the left of the detachment) takes a pace to his front, turns to his right and numbers himself 1;

* Without traversing gear.

R.M.L. Ordnance (9-inch).**Section I.**

the right hand man of the rear rank numbers 2, the right hand man front rank 3, the second man from the right of the rear rank 4, the man in his front 5, and so on. After the detachment is told off No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery and halted in line facing the shield, and to the left rear of the platform. The detachment is now in the position of "detachment rear."

TO TAKE POST UNDER COVER.*Officer.**No. 1.**Take post under cover.**Right turn.**Double march.*

The detachment stepping off, wheels to its left at the left corner of the platform, the front rank filing to the left of the gun, the rear rank to the right, 2 and 3 halting close to the shield and near the port, 4 and 5 forming upon their right and left, and the whole turning to the right about together. No. 1 follows in the rear of the detachment, keeping under cover as much as possible. 6 and 8 go to the cartridge store (6 outside) 7, 9 and 10 to the shell store (7 and 9 outside).

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, and lays.

No. 2 searches, sponges, steadies and guides projectile in raising, rams home, runs up and elevates, attends to mantlets.

No. 3 sponges, steadies and guides projectile in raising, loads, uncaps the fuze when in the bore, rams home, runs up, and elevates, attends to mantlets.

No. 4 attends to side arms, supplies them to 2, and traverses.

No. 5 attends to vent, raises projectile, supplies wedge wads, traverses, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes, brings up projectile, raises and rams it home.

No. 8 attends to cartridge store, serves out cartridges to 6.

No. 9 assists 7, raises and rams home projectile, removes empty barrow.

No. 10 attends to shell store, issues shells, tubes, and fuzes.

With Elswick compressor 4 attends to compressor lever.

TO PREPARE FOR ACTION.*Officer.**No. 1.**Prepare for action.*

Prepare for action.
Examine gun.

Section I.

R.M.L. Ordnance (9-inch).

No. 1 provides and fixes sights.

No. 2, iron pointed lever and assists 4 with side arms.

No. 3, iron pointed lever, elevating wheels, hoisting tackle, double and single blocks, and removes the tampon from the muzzle.

No. 4, side-arms and two rammer ropes when fitted with spring clips.

No. 5, pricker and vent server, wedge wads, two iron shod levers, tubes in box and lanyard. When the 9-inch gun is fitted with traversing gear he provides the handle and running back tackle instead of two levers.

No. 6, bucket, filled, and brush (one zinc cartridge cylinder and one dummy cartridge, for drill purposes only).

No. 7, fuzes, fuze and shell implements, and two straps for slinging projectile; he obtains the fuze boxes from 10, satisfying himself as to the correctness of fuzes and fuze implements.

No. 8 goes to cartridge store and prepares to issue cartridges.

No. 9, transporting barrow and a brush.

No. 10 goes to shell store and prepares to issue shells, tubes, and fuzes, he examines the shells carefully, cleaning them if necessary, and removing burrs from studs; he loosens the fuze hole plugs of shells that will be first issued.

8 and 10 satisfy themselves that the lamps in the ammunition stores are burning brightly, and that the hoisting gear at the cartridge and shell lifts works easily.

Any irregularity in these respects should be at once reported to No. 1.

The stores having been brought up, or found correct, No. 1 will satisfy himself that the foresights fit properly on the gun, and the deflection leaves of the hind sights work easily, that the clip plates are secured to the carriage; he ascertains that the hydraulic buffer is filled with the proper amount of oil or that the compressor is in adjustment and that the racers are swept; he receives reports from the Nos. responsible of any irregularity or deficiency in connection with the different parts of the gun, carriage, platform, and stores, or as regards the ammunition stores, lifts, &c.

2 and 4 place the sponge and rammer in the supports on the right side of the platform, the shell extractor and wadhook in rear so as not to interfere with the working of any of the guns in the battery, and convenient for those for which intended.

2 sees that the elevating gear, 4 that the traversing gear is oiled and in good working order.

2 and 3 place the iron pointed levers in their supports on the platform, they should satisfy themselves that the mantlets work easily.

3 examines the bore to see the grooves are free from grit &c., he secures the hoisting tackle to the loading bar, overhauling it till the lower block is at a convenient height for hooking to the strap on the projectile; the lower block should then be hooked

R.M.L. Ordnance (9-inch).

Section I.

back to a loop on the left mantlet to keep the tackle out of the way until required.

4 coils down the rammer ropes on either side of the gun.

5 straps the tube box round his waist on the right side, coils up the lanyard, and passes the bight of it under the tube box strap; fills his box with friction tubes which he procures from 10; places the iron shod levers (if required) on the ground parallel to and either side of the gun or reeves the running back tackle; he places the pricker in the loop, examines the vent server and places it in the vent, the loop of the vent server lanyard over one of the sights.

6 supplies the trough (for the reception of the sponge head) with water from the bucket, and places the latter clear of the working of the gun.

When the carriages are not fitted with running back gear, 7 and 9 bring up two sets of tackle, double and treble blocks, hook the double blocks to the rear eyebolt of the platform, round in the tackle and coil down the fall.

"*Examine gun*," No. 5 drifts the vent, replaces the pricker in the loop, and the vent server. 2 searches the gun after the pricker is withdrawn, supplying himself with the wadhook and replacing it.

4 or 5 elevate until No. 1 gives "*Halt*," which he does when the gun is in a convenient position for sponging and loading; the whole of the numbers take post under cover.

When levers are used for elevating, 4 and 5 will clamp at "*Halt*."

TO LOAD.

<i>Officer.</i>	<i>No. 1.</i>
<i>Range</i> ——— <i>yards.</i>	<i>With</i> ——— <i>load.</i>
<i>With</i> ——— <i>load.</i>	

"Load."

No. 1 gives 7 the nature of shell (and length of fuze required) and adjusts the tangent scale. No. 2 moves into position for sponging, receives the sponge from 4, and assisted by 3, sponges as soon as the vent server is in the vent. He returns the sponge to 4 and with 3 steadies the projectile in raising and guiding it into the bore; he then receives the rammer (with right rammer rope attached) from 4, and as soon as the cartridge and projectile are in the bore he rams home assisted by 3, 7 and 9; should "*Not home*" be given by 2 the charge will be forced home. At "*Home*" 2 and 3 detach the rammer ropes (if fitted with spring clips) and hand them to 4 and 5; 2 springs the rammer assisted by 3; 3 inserts a wedge wad; 2 and 3 press it steadily home, jamming it under the

Section I.

R.M.L. Ordnance (9-inch).

head of the projectile with two smart taps; the rammer is sprung as before, 2 returns it to 4 and both go under cover.

No. 3 moves into position, and having assisted 2 to sponge, slews to his right, draws the cartridge from the cylinder with his left hand, choke to his left, and places it in the bore.

The projectile is now brought up on the barrow with strap ready fixed; 3 standing clear close to the front of the platform, 5 casts loose the lower block of the hoisting tackle, 3 hooks it into the strap and gives "*Hoist away*," and with 2 steadies and guides the projectile which is raised by 5, 7 and 9 manning the running end of the fall; 3 gives "*High enough*," "*Ease off*," and having with 2 forced the projectile into the bore casts loose the strap, replacing it in the barrow; he uncaps the fuze; if the rammer ropes are fitted with spring clips he now hooks that on the left side receiving it from 5; after ramming home the charge he detaches the left rammer rope, hands it to 5, and assists 2 to spring the rammer; he receives a wedge wad from 5, places it in the bore, and with 2 presses it home and springs the rammer.

No. 4 hands the sponge to 2 and replaces it. He supplies the rammer as soon as the projectile is in the bore and replaces it, attending to the right rammer rope. He cleans and damps the sponge.

No. 5, as soon as the cartridge is in the bore, casts loose the lower block of the hoisting tackle, and mans the fall in raising the projectile; he attends to the left rammer rope, and when the charge is home supplies 3 with a wedge wad; he hooks the lower block of the hoisting tackle to the loop on the left mantlet.

No. 6 supplies a cartridge to 3 (bringing it up on his shoulder, lid to the rear), standing at his right rear and keeping the cylinder closed till the sponge is out of the bore.

No. 7 brings up the projectile with strap on in barrow, assists to raise and ram it home.

No. 8 issues a cartridge to 6.

No. 9 assists 7 to prepare, bring up, and raise projectile, rams home (on the right of the gun), and removes empty barrow.

No. 10 issues shell.

N.B.—When rammer ropes fitted with spring clips are not in use they are coiled down between the racers close to the piers by 4 and 5.

TO RUN UP.

Officer.

No. 1.

Run up.
Halt.

"*Run up*," 2 and 3 put the iron pointed levers into the sockets and bear down; should it be observed that the gun is running up too rapidly 2 and 3 raise their levers and check it.

When the gun is in position No. 1 gives the word "*Halt*."

R.M.L. Ordnance (9-inch).

Section I.

2 and 3 raise the levers till the sockets touch the stop plates. They then replace them. No. 5 hooks a tube to the lanyard, 2 and 3 close the mantlets.

TO LAY THE GUN. (See SECTION IV., PAGE 336.)

Officer.No. 1.*Elevate. Halt.**Depress. Halt.**Trail right. Halt.**Trail left. Halt.*

2 or 3 works the elevating gear; but if it is found that the gear works stiffly, both Nos. may be employed, provided they work at the same speed; 4 and 5 work the traversing gear.

If the rear trucks are fitted to receive the iron pointed levers 4 and 5 apply them; if not so fitted iron-shod levers or tackles must be used, 6 and 7 assisting, if necessary. Should no order to fire be given when the gun is laid, No. 1 will give the word *Under cover.*"

TO MAKE READY AND FIRE.

Officer.No. 1.*Fire—rounds.**No.—Ready.**No.—Fire.*

At "*Ready*" the gun numbers stand clear. No. 5 places the tube in the vent, descends from the platform, passes the lanyard through the rear eye-bolt of the carriage and stands ready to fire, facing the gun. At "*Fire*" he draws the lanyard strongly toward him without a jerk; he drifts the vent, replaces the vent server and pricker, and coils up the lanyard, placing it under his belt.

When platforms are fitted with traversing gear, 4 and 5 will as soon as the gun has been fired, at once traverse it back to a position convenient for loading, without any word of command.

TO RUN BACK AND UNLOAD.

Officer.No. 1.*Run back. Halt.**Unload.*

At "*Run back*," with gear, No. 1 disconnects the traversing pinions by shifting and keying up the handle. He follows up the right front truck with a scotch; 2 and 3 apply their levers and bear down, 4 and 5 attend to pawls and heave round the travers-

Section I.

R.M.L. Ordnance (9-inch).

ing handles, 6 and 7 fix the running back tackle, holding on the fall and removing the tackle when the gun is back.

With tackle, No. 1 follows up the right front truck with a scotch; 2 and 3 apply their levers and bear down; 4 and 5 fix pawls; 2 and 3 withdraw their levers and replace them, overhaul the tackle and hook the treble blocks to the front eye-bolt of the carriage. The tackles are manned by all the available numbers on their own sides; additional men will usually be necessary. No. 1 gives "Halt" when 2 and 3 apply their levers and bear down; 4 and 5 release the small pawls.

In either case when the gun is back 4 and 5 unhook the front blocks and lay them down after overhauling the tackle. The gun is unloaded by the numbers who loaded it.

TO CEASE FIRING AND REPLACE STORES.

<u>Officer.</u>	<u>No. 1.</u>
<i>Cease firing.</i>	<i>Depress. Halt.</i>
<i>Replace stores.</i>	<i>Replace stores.</i>

The gun is depressed, and the stores are replaced by the numbers who brought them up.

TO FORM DETACHMENT REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Outwards turn.</i>
	<i>Double march.</i>
	<i>Halt.</i>
	<i>Front.</i>

"*Detachment rear.*"—No. 1 doubles to the left rear of the platform, faces to the left, and gives the order "*Outwards turn,*" 2 and 4 turn to their left, 3 and 5 to their right.

"*Double march.*"—4 and 5, followed by 2 and 3, wheel to the right and left, and when clear of the platform to the right, and round No. 1's left shoulder, 6, 7, 8, 9 and 10 coming up into their places; when 2 and 3 have passed him, No. 1 gives "*Halt,*" "*Front,*" and changes his flank by the rear.

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change Rounds.</i>	<i>Change Rounds.</i>

No. 2 becomes 4; 4, 1; 1, 10; 10, 9; 9, 8; 8, 7; 7, 6; 6, 5; 5, 3; 3, 2.

SERVICE OF 9-INCH GUNS IN BARBETTE BATTERIES.

The guns are fitted with muzzle derricks. The service is the same as for guns mounted in casemates and behind shields, with the following exceptions:—

"General Duties."—5 attends to muzzle derrick.

"To prepare for action."—Rammer ropes are not supplied.

The barrow given in list of changes in stores 2166—14½ inches track can be used.

"To load."—5, as soon as the cartridge is in the bore, raises the derrick and overhauls the tackle; after supplying 3 with a wad he rounds in the tackle and throws back the derrick. In ramming home, 7 and 9 man the rammer stave with 2 and 3, 9 on the right.

N.B.—If the guns are not fitted with muzzle derricks, the projectile must be carried to the gun in a shell bearer by 7 and 9, 2 and 3 assisting in raising it to the muzzle.

9-INCH R.M.L. MONCRIEFF CARRIAGE. MARK II.

CONSTRUCTION.

This carriage is constructed in a similar manner to that for the 7-inch R.M.L. of 7 tons, but the sides of the platform are of girder iron 19 feet 9 inches long by 12 inches deep, and 6½ inches wide in the flange; each side is strengthened by ¾-inch plate riveted along the under flange of the girder.

The platform is supported upon six trucks, each 2½ feet in diameter, the centre being to the front of the pivot and set to the same radius as rear trucks are to the rear of it. Traversing gear is applied to the left front and left rear trucks as in the 7-inch platform. In the gear for moving the elevator by hand additional power is gained by introducing a pinion to drive each ratchet wheel on the brake shaft, the pawl of the lever socket acting in the pinion.

For raising the projectile in loading by means of a chain a small windlass is fitted on the inside of the left side of the platform, having a spur wheel on its spindle outside the platform, which is driven by a pinion and hand-wheel.

Beneath the centre of the platform a tray to receive the shot truck when it brings up the projectiles is fitted, and longitudinally between the sides of the platform in rear there is a tray for holding the side-arms.

The carriage is designed to admit of the gun firing over a parapet 12 feet 6 inches high.

DRILL WITH 9-INCH R.M.L. GUN ON MONCRIEFF
CARRIAGE. MARK II.

The detachment consists of 10 Nos., is told off, and takes post under cover, as with the same gun mounted on a traversing platform.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, attends to the brake in running up, and lays. He makes ready if the gun is laid by the tangent sights.

No. 2 searches, sponges, steadies, and guides the projectile in raising, rams home, attends to lever, and elevates.

No. 3, sponges, steadies, and guides projectile in raising, rams home, attends to lever, and traverses.

No. 4 attends to side-arms, assists at lever, attends to ratchet pawls, and traverses.

No. 5 attends to vent, supplies wedge-wads, traverses, makes ready and fires.

No. 6 supplies 3 with cartridge, and traverses.

No. 7 attends to fuzes, brings up projectile, raises it, assists to ram home if required.

No. 8 attends to the cartridge store, serves out cartridges to 6.

No. 9 assists 7, raises projectile, assists to ram home if required, removes empty barrow.

No. 10 attends to shell store, issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

As with the gun on a traversing platform, with these exceptions, viz.:—

3 brings up handle for hoisting winch instead of tackle.

4, handle for traversing, no rammer ropes are required.

5, iron-shod levers not required.

No. 1 should ascertain that the brake is in working order.

2 and 4 place the sponge and rammer in the tray between the sides of the platform.

7 and 9 bring up two sets of heavy gun tackle and four selvagees.

At "Examine Gun," 2 and 5 perform the same duties as at 9-inch R.M.L. on traversing platform; 4 supplies 2 with wad-book; 4 and 5 are not required to elevate.

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Section I.

TO LOAD.

As with the gun on traversing platform, with the following exceptions:—

2 supplies himself with sponge and rammer, screwing on the extra lengths to staves when necessary, and replaces them.

No rammer ropes are used.

3 slews to his left to receive the cartridge, and having drawn it from the cylinder by the choke, reverses it, and places it in the bore.

The projectile on the barrow, with strap ready fixed, is run under the platform below muzzle of gun, the flaps of loading stage are opened by 2 and 3, and the hoisting tackle hooked by 3; 7 and 9 then hoist the projectile by means of the winch-handle, they assist to ram home if necessary.

6 stands at the left of 3 with cartridge.

RUN UP.

No. 1 gives the commands "*Run up.*" "*Stand clear.*"

At run up 2 and 3 place their levers in the sockets, small ends to front, and bear down; 4 and 5 throw up the ratchet pawls as soon as they are clear; 2 and 3 withdraw the levers and lay them down.

At "*Stand clear*" all the Nos. stand clear of the gun. No. 1 bears down on the brake handle and allows the gun to rise; if rising too fast, he checks it by raising the handle, but must not do so too suddenly.

At "*Half*" 4 and 5 replace the pawls in the ratchets.

TO LAY THE GUN. (See Section IV., page 336).

2 works the elevating wheel; 3 and 4 traverse in front, 5 and 6 in rear.

TO MAKE READY AND FIRE.

If the gun is laid by the tangent sight, No. 1 makes ready, receiving tube and lanyard from 5. If the gun is laid from under cover, 5 makes ready before it is run up.

TO RUN BACK AND UNLOAD.

Extra Nos. should be employed, to save time.

It may be done with the levers alone placed in the sockets; at "*Run back*," small ends to front by 2 and 3, and keyed up by

Section I.

R.M.L. Ordnance (10-inch).

4 and 5. 2, 4, and 6 then bear down on the right lever, 3, 5, and 7 on the left lever; at the word "*Down*" taking fresh purchases together.

If tackles are used, they are hooked by 7 and 9, assisted by 6 and 8.

At "*Unload*," which is done by the Nos. who loaded (when the gun is in the loading position), 4 supplies 2 with the shell extractor and wad hook, passing them under the gun.

TO CEASE FIRING, AND REPLACE STORES.

TO FORM DETACHMENT REAR.

TO CHANGE ROUNDS.

As detailed for 9-inch R.M.L. gun on traversing platform.

10-INCH R.M.L. GUN.

DESCRIPTION.

Calibre	..	..	..	..	10 inches.
Nominal weight	..	..	..	..	18 tons.
Preponderance	..	..	..	..	Not exceeding 3 cwt.
Length	{	of bore	..	..	12 feet 1.5 inches.
		of rifling	..	..	9 feet 10 inches.
		total	..	..	15 feet.
Rifling	{	grooves, number	..	7	
		spiral increasing from 1 in 100 to 1 in 40 calibres.			
Chamber, conical.					

DIFFERENT PATTERNS.

There are only two patterns of this gun, differing from each other in Mark II. having a thinner steel tube, and two coils over the breech instead of one.

EXAMINATION OF GUNS.

The guns will, as far as possible, be examined regularly after firing every 50 rounds with projectiles by the Inspector of Warlike Stores at stations where there is one; at other stations under the

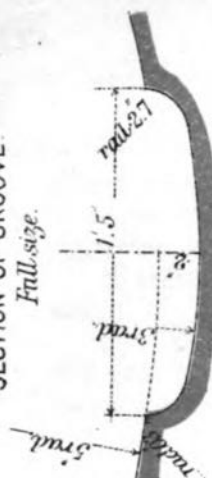
ORDNANCE WROT IRON MUZZLE LOADING GUN 10 INCH 18 TONS. R. MARK II.

19. 7. 69 $\frac{73}{3}$ 8907

WEIGHT 17 TONS 19 CWT. 1QR. 17 LBS.
PREPONDERANCE 1. 0. 18.

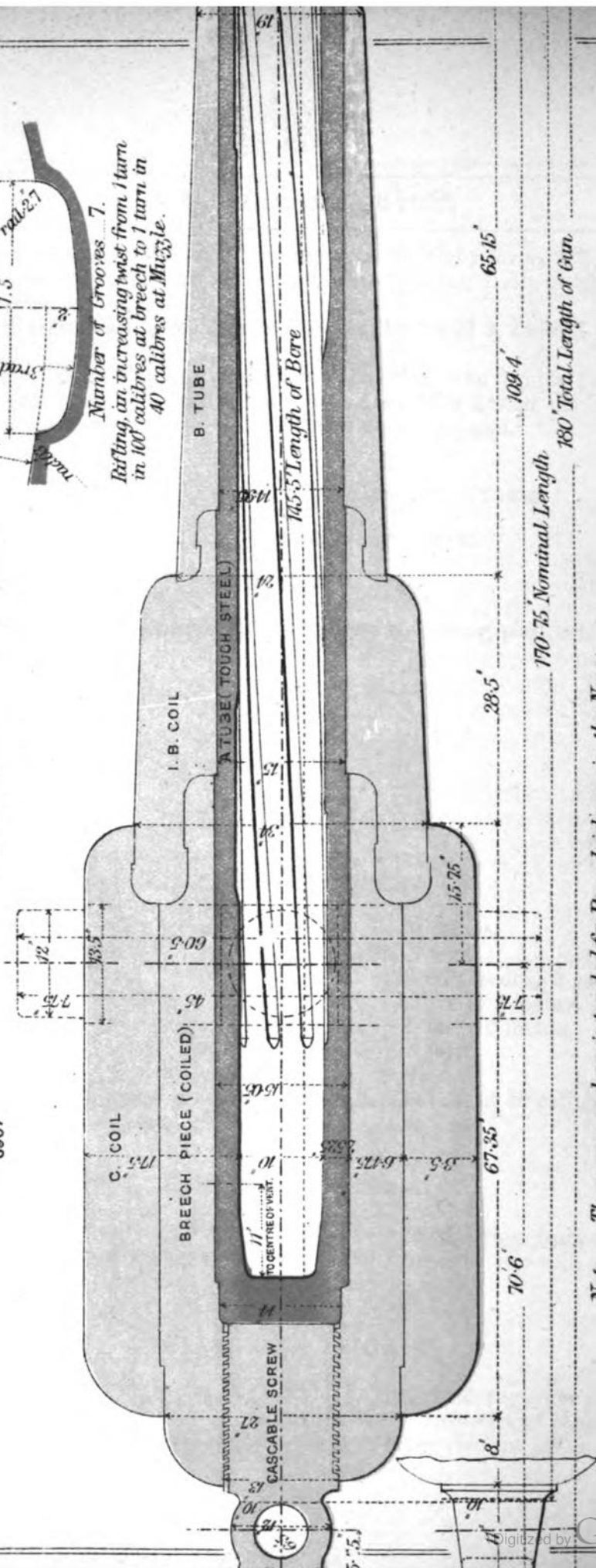
SECTION OF GROOVE.

Full size.



Number of Grooves 7.

Rifling, an increasing twist from 1 turn in 100 calibres at breech to 1 turn in 40 calibres at Muzzle.



Note. — These guns when intended for Broadside use in the Navy and for Land Service are vented upon the right-hand side at an angle of 45° with the vertical axis of gun. But when employed in double gun turrets are vented right and left, i.e. upon the outsides of their respective positions.

R.M.L. Ordnance (10-inch).**Section I.**

direction of the officer commanding the Royal Artillery in the district.

The bores of guns from which practice is carried on, should be kept slightly oiled to prevent rusting. At the close of each day's practice they will accordingly be washed and placed under metal, and as soon as dry will be oiled with a sponge, and the muzzles closed with tampons. When guns are not in use the bores will be lacquered.

CONSTRUCTION.

For pieces heavier than the 9-inch, the weight of the jacket is still further reduced by making it much shorter in front of the trunnions. The portion thus taken off the jacket is put on as an additional coil over the steel tube in front of the jacket.* This is called the 1 B coil or belt.

The 10-inch, Mark II., and higher natures of those manufactured since 1869 (up to 81-ton gun) consist of—

A tube (toughened steel); B tube; 1 B coil (belt); coiled breech piece; C coil (jacket); cascable.

RIFLING.

The rifling of guns of 10 inches and upwards is on the Woolwich system as described for the 7-inch R.M.L. gun, but with an increasing twist.

The depth of grooves in 10-inch guns and upwards is 0.2 inch.


VENTING.

The gun is vented on the right side at an angle of 45° with vertical axis, at a distance of $\frac{1}{10}$ of the length of the cartridge from the bottom of the bore.

SIGHTING.

The gun is provided with 6 sights, viz.:—

Two tangent scales, one on each side, graduated up to 12° , and furnished with deflection leaves. The bar of the sight is four-sided, and marked as follows:—

	DEGREES.				
COMN. SHELL BATTG.	{	YDS.		FUZE }	COMN. SHELL.
70 LB. P.		FUZE			YDS.	FULL, 44 LB. P.
PALLISER SHOT					
OR SHELL BATTG.					
YDS. 70 LB. P.					

* Mark I. of 10-inch and 11-inch guns, of which only a few were made, had their jackets made as in the 7-inch, while the four 12-inch of 25 tons, Mark I., were of original construction.

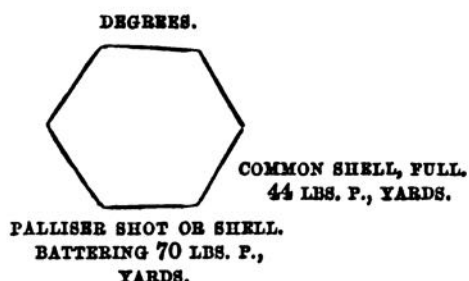
(A. M.)

R

Section I.

R.M.L. Ordnance (10-inch).

One centre hind-sight. This is a short scale, with deflection leaf on the head, graduated to 8° ,* for use at close quarters and moderate ranges. It works in a gun-metal socket fixed in the gun, and is provided with a set screw; is six-sided, and marked as follows:—



Two trunnion sights. The sight consists of a pillar, collar, and socket of gun-metal, a steel leaf, and screw for fixing the leaf. The socket is permanently fixed in the gun; the pillar and collar each lock into it with a bayonet joint—so that when once the sight is in its true position it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle.

One centre foresight. Similar to the trunnion sight.

PROJECTILES, WITHOUT GAS CHECKS.					Weight. lbs.
Shot	case filled with 139 8-oz. sand shot, clay, and sand				143
	Palliser, cored	empty .. .. .	..	..	400
		with 4 lbs. bursting charge			404
Shells	common †	empty .. .. .	..	..	377.75
		with 20.25 lbs. bursting charge in bag			398.25
	Palliser	empty .. .. .	..	..	391.875
		with 6.875 lbs. bursting charge in bag			398.875
	shrapnel	Filled with 306 4-oz., or 376 3½-oz. sand shot with 1 lb. 9 oz. bursting charge			404.6
		Gas check, weight of			

Case shot is used for close quarters against troops or boats.

Palliser projectiles. Both shot and shell are used against iron-clads.

Common shell is used against shipping.‡

CHARGES.

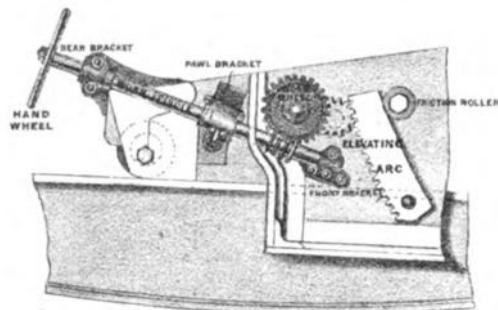
Battering ..	70 lbs. P. or 60 lbs. R.L.G. powder.
Full ..	44 lbs. P. or 40 lbs. R.L.G. powder.

* The old pattern centre hind-sight is graduated to 5° only, and has no deflection leaf.

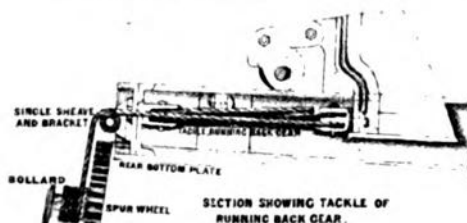
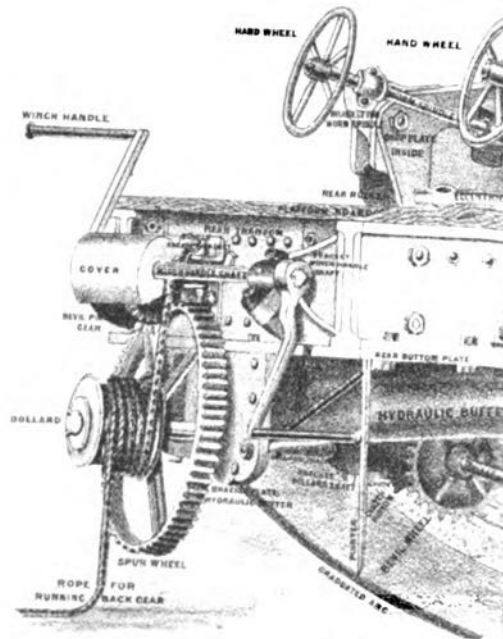
† Some of these shells will be found without unloading holes, which have now been discontinued in manufacture.

‡ If required, the common shell may be fired with battering charges.

NOTE.—On all occasions a blank or scaling charge of 44 lbs. P. powder, will be fired from each gun before commencing practice from guns newly issued.



SECTION SHOWING THE ELEVATING GEAR
(INSIDE THE BRACKET)



SECTION SHOWING TACKLE OF
RUNNING BACK GEAR.

R.M.L. Ordnance (10-inch).

Section I.

10-INCH R.M.L. GUN.

Charge, 70 lbs. P. Projectile, with Gas-check, 410 lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1400	5570·7	178·75
500	1328	5012·4	160·84
1000	1262	4526·5	145·24
1500	1202	4106·4	131·76
2000	1147	3739·2	119·98
2500	1097	3420·3	109·75
3000	1054	3157·4	101·31

FUZES.

Time, 15-seconds M.L.O. for use with Shrapnel.

Percussion, Pettman, general service, for sea fronts, for use with common shell intended to burst on impact.

CARRIAGES.*

Sliding carriages for 10-inch guns are of the double-plate construction, where the brackets are formed of two plates of wrought-iron riveted to a framework of bar-iron fitted between them. They are fitted for hydraulic buffers.

The carriages are employed both as dwarf and casemate, the difference in height being given by the platform.

Each carriage consists of—

2 brackets	2 front rollers with axles and $\frac{1}{2}$ -inch split keys
1 front transom	2 rear rollers with eccentric shaft
1 rear transom	2 front clip plates
1 bottom plate	Elevating gear
2 capsquares with keys	

On the right and left brackets a reader or small block of gun-metal with pointer is attached by two screws for use in connection with the index plate attached to the breech of the gun.

The capsquares are interchangeable and reversible on both sides of the carriage.

The clip plates prevent the carriage from jumping up when the gun is fired. They are fitted one on each side through slots cut in the angle-guides beneath the carriage, and secured each by

* A second pattern of 10-inch low casemate carriage and high platform has recently been introduced into the land service. The carriage is a modification of the naval pattern. It weighs 67 cwt. and its height above platform is 23 inches. The high platform, however, brings the axis of gun to the same height as in Mark I. carriage. The platform weighs, with buffer and gear, 106 cwt., and 18-inch trucks are used both in front and rear.

Section I.

R.M.L. Ordnance (10-inch).

two bolts through the bottom, which they clip to the upper flange of the platform girders. Before the carriage can be dismounted from the platform, the clip plates must be removed.

The casemate carriage and platform will fire over a 2 feet 6 inch genouillère; the height of the axis of gun above the top surface of racers is 4 feet $2\frac{1}{2}$ inches.

The dwarf carriage and platform will fire over a 4 feet 3 inch parapet, the height of the axis of gun being 6 feet above the top surface of racers.

The carriage allows of 10° elevation and 7° depression. Its weight is $51\frac{1}{2}$ cwt.

In order to preserve the carriages in a proper working condition, the axles, spindles, pinions, &c., and also their bearings, must be kept clear of clotted oil and rust, and well lubricated.

In putting the gear on a carriage, should a screw go very tight, it must be withdrawn and examined, and if it is found that the bearing or screw has been indented, the burr must be carefully removed with a file.

TABLE OF WEIGHTS OF CARRIAGES FOR 10-INCH R.M.L. GUN.

Nature.	Weight with gear.	Diameter of Rollers or Trucks.	
		Front.	Rear.
10-inch R.M.L. { fitted for buffer (high) ..	cwts. qrs. 51 1	in. 12	in. 8
double plate. { Scott's pattern (low) ..	67 0	13	8
" small port ..	120 0	12	8

WORM-WHEEL AND WORM ELEVATING GEAR.

Consists of an endless screw and worm-wheel placed on the inside of each bracket and connected with the elevating arc by common toothed pinions.

The gear is worked by a hand-wheel fixed to the shaft of the endless screw at the rear of the carriage; no clamps are needed to secure the gun from running down.

The gear is fitted on both sides of the carriage; either set may be used, or both together. The side not in use must be thrown out of gear by turning a stud-key, and raising a pawl, when the endless screw can be turned out of gear, and secured by replacing the pawl.

Bearings of shafts, worm-wheels, gearing-wheels, and pinions must be kept clean, and the frictional surfaces properly lubricated.

INDEX PLATE AND READER.

In order to facilitate the elevating of 9-inch guns and upwards mounted on casemate platforms, a gun-metal arc, termed an

R.M.L. Ordnance (10-inch).

Section I.

"index plate," is secured to each side of the gun, near the breech end, by two screws. These arcs are graduated for 10° elevation down to 6° depression, and a gun-metal pointer, termed "reader for index plate," is secured to the carriage, so that the number working the handle of the elevating gear can see when the required elevation is given.

TRAVERSING PLATFORMS.

Traversing platforms for 10-inch guns are constructed of wrought iron on what is known as the "fish-bellied" system, and are dwarf or casemate.

The platform is 15 feet in length, and has a slope of 4° . It is fitted with brackets on the side for the reception of the sponge, rammer, and iron-pointed levers. A water tank is attached to the rear of the right side of platform for wetting the sponge head.

The weights of platforms and diameters of the trucks used with each nature of platform and pivot are as follows:—

				Diameter of Trucks.		Average weight with buffer and gear.
				Front. inches.	Rear. inches.	
Casemate	{ low high }	A pivot	{	10	13	95½ cwt.
				18	18	106½ "
Dwarf	{ A pivot C D }	.. ..	{	18	24	134½ "
				24	24	140½ "
				24	18	141 "

HYDRAULIC BUFFER.

The object of using the buffer is to reduce the recoil of the carriage within the desired limits, which is accomplished as follows:—

The cylinder being rigidly fixed to the rear of the platform, and the end of the piston rod fixed to the front of the carriage, when the carriage is run up the piston rod is drawn out of the cylinder nearly its full length, and the piston drawn to the front end of the cylinder, the oil passing to the back of the piston. As the carriage recoils it forces the piston rod with the piston up the cylinder, the resistance to its passage by the oil checking the recoil, the oil passes from the rear to the front of the piston through the holes in it, therefore the size of the holes is regulated by the velocity of the recoil; the larger the charge the smaller the holes must be. The resistance offered by the oil increases with the velocity of the piston, and *vice versa*.

The cylinder not being entirely filled with oil, the air in the unfilled space acts as an elastic buffer.

The same buffer is adapted for use with all heavy rifled M.L. guns from 7-inch to 12-inch of 25 tons, but the piston holes vary in size for the different natures.

Four holes for use with the 10-inch gun, 0·8 inch diameter, are drilled in the piston to allow of the passage of the oil.

Section I.

R.M.L. Ordnance (10-inch).

To fill the cylinder with oil, run the carriage up to the stops, take out the screw plug and rest the gallon measure in the hole, turn off the cock and fill the measure with mineral oil to the gallon mark, then turn the cock and allow the oil to flow into the cylinder; repeat the operation until the quantity required is run in. The greatest quantity of oil used should not exceed 12 gallons, which, with the carriage run out, will be $4\frac{1}{2}$ inches deep at the filling hole; this depth may easily be tested by a slip of wood; oil is withdrawn by means of the front cock, air being let into the cylinder at the same time by the removal of the rear plug.

A zinc pan, to catch any dripping of oil from the gland in firing, is suspended in front of the buffer.

When not required for constant use, the buffer may be removed and placed in store, the oil being run out; though if required for occasional use it may be left filled and periodically examined.

A common spanner, for use in loosening or tightening the packing gland of the buffer, will be issued in the proportion of one per work or battery; a double headed spanner for the purpose of removing the screw plug, and turning or tightening the cock is supplied with each buffer, and McMahon's spanner is used for screwing and unscrewing the nuts and collars.

TRAVERSING AND RUNNING BACK GEAR.

The traversing gear consists of a combination of common tooth gearing which acts directly on two of the four trucks of the platform, causing them to revolve, to traverse the platform right or left as desired. The gearing is set in motion by a winch-handle placed at the rear or side of the platform.

The running-back gear consists of part of the traversing gear, combined with a revolving bollard and special block tackle. A clutch pinion is provided, which, by means of a lever, is connected or disconnected with the truck pinions, by which means the part of the gear connected with the running-back may be set in motion without acting on the trucks of the platform. The same winch-handle works both the traversing and running-back gear.

RACERS.

The new pattern racers for 10-inch guns and upwards are of steel, and, with the exception of "A" pivot rear racers, are bevelled on their upper faces to suit the trucks, which are coned true to their respective distances from the pivots. In section the racers are formed with a broad bottom flange and a rib rising in the centre to suit the hollow soled trucks; this rib tapers towards the top so as to allow the trucks to revolve freely without grinding against the racer.

The bedding-plates are of wrought iron, 6 inches wide, 1 inch thick; they are made of the total length of the racer, and in pieces, so as to break joint with the racer joints.

R.M.L. Ordnance (10-inch).

Section I.

The racer is secured to the bedding-plate by steel bolts with wrought-iron nuts. The bolts are $\cdot 75$ inch diameter, and 2·625 inches long, and the nuts are $\cdot 75$ inch deep.

The stops are attached to the side of the racer instead of on the top, as hitherto.

The old pattern racers are of wrought iron, and of the same section for all guns of 7 tons and upwards, viz. :— $2\frac{1}{4}$ inches wide and $2\frac{1}{4}$ inches deep, and are bedded $\frac{3}{4}$ inch in masonry; the upper surface generally being laid flush with the floor. Racers of railway bars have also been approved for certain cases.

The radii of the racers are as follows :—

Pivot.	Front.	Centre.	Rear.
	ft. in.	ft. in.	ft. in.
A*	8 0	..	18 0 } Dwarf and casemate.
C	9 ..	8	.. } Dwarf.
D	9 0	..	3 0 }

GRADUATED ARC AND POINTER.

To indicate the angle of traverse a wrought-iron pointer is attached beneath the rear of platform, which points to a graduated arc let into the floor of the work. The graduations on this arc numbered towards the right from 0° on the extreme left.

PRESERVATION OF SIGHTS AND FITTINGS.

See page 216.

CARRIAGE, "SMALL PORT," FOR 10-INCH RIFLED M.L. GUN.

GENERAL DESCRIPTION.—CARRIAGE.

Is designed for working guns in small ports which would admit of only a limited range of elevation by the ordinary method. To obtain the full elevation and depression, viz., 9° and 4° , a vertical rise and fall of 12 inches within the carriage is allowed to the trunnions without interfering with their ordinary movement. To admit of this rise and fall two moveable trunnion blocks are provided, which are free to slide vertically with the gun in recesses formed in the carriage brackets. The positions of the gun most suitable for laying at the various elevations and depressions are shown by an index pointer on the left carriage bracket.

* Except some made for Malta and Gibraltar.

Section I.

R.M.L. Ordnance (10-inch).

There are two distinct sets of gear for raising the gun, namely, a "hydraulic lift," which acts directly on the underside of the gun at the centre of the carriage; and a "screw lift," which acts on the trunnion blocks, and is intended to be used either to follow up the "hydraulic lift" and take the weight of the gun for firing, or as an alternative in the event of the hydraulic gear being disabled.

HYDRAULIC LIFT.

Consists of a self contained hydraulic ram and cistern with double acting pump, fixed on the bottom of the carriage under the centre of the gun, and in a line with the trunnion recesses. The head of the ram carries a plate secured to it, but free to oscillate, which fits against the lower side of the gun while it is being raised; the ram is worked up by a pump lever on each side of the carriage, two men on each lever being sufficient, while the lowering is accomplished by folding the stop on left bracket out of the way of the lever, and forcing the pump lever down. Care must always be taken before firing that the weight of the gun rests on the screws. The ram is arranged in the carriage so as to be easily removed if disabled. It rests on supporting plates, which being withdrawn allow the ram to be lowered through the bottom plate of the carriage.

SCREW LIFT.

In the screw lifting arrangement, each trunnion block rests directly on a vertical screw, placed between the bracket plates of carriage, and worked by a nut formed in the boss of a horizontal bevel wheel; suitable toothed wheels and pinions connect this wheel with a longitudinal shaft lying inside each bracket extending to the rear of the carriage, where it is connected by toothed wheels to cross shafts, the ends of which project beyond the sides of the carriage, and are fitted to be worked by winch handles. By working the foremost cross shaft sufficient power is obtained to lift the gun by means of the screws, whereas the rear cross shaft furnishes a "quick speed" movement by which the screws, and consequently the gun, may be lowered rapidly—and also raised rapidly for "following up" the trunnion blocks when the gun is raised by the hydraulic lift.

ELEVATING GEAR.

This gear is very similar to the service worm wheel arrangement, but has a straight rack attached to the gun by a link, instead of the usual circular arc, and is fitted with a cone friction clutch. The rack is free to move in a vertical guide, inside the carriage bracket, and the link accommodates itself to the movement of the gun. Elevating plates are required for the reception

R.M.L. Ordnance (11-inch).

Section I.

of the steel pivots which secure the links above-mentioned to the gun. They consist of two gun metal plates or brackets fitted to the gun in the position shown in plate, and are secured to the gun by 5 screws. The steel pivots which screw into them are of the ordinary service pattern, and can be readily removed and replaced by the wrench issued for that purpose.

PLATFORM.

Is of the Mark I. service pattern but raised 6 inches, and has the usual casemate "side" arrangement of traversing and running-in-gear. As the space at the centre of the slide is required for the movement of the hydraulic ram during recoil, two hydraulic buffers are fixed near the sides of the platform instead of one at the centre—the holes in the piston are consequently enlarged to 1.0 inch diameter instead of 0.8 inch.

Gain of power by	{	screw following-up gear	.. ..	827 to 1
		" lifting "	.. ..	2480 to 1
		hydraulic lifting gear	.. ..	457 to 1
		traversing gear	.. ..	40 to 1
		running-back gear	.. ..	205 to 1

11-INCH R.M.L. GUN.

DESCRIPTION.

Calibre	.. ..	11 inches
Nominal weight	.. ..	25 tons
Preponderance	.. ..	2 cwt.
Length	of bore	12 feet 1 inch
	of rifling	9 feet 11 inches
	total	15 feet 2½ inches
Rifling	grooves, number	9
	spiral increasing from	0 to 1 in 35

DIFFERENT PATTERNS.

There are two patterns of this gun, only 7 of Mark I. having been made.

CONSTRUCTION.

Mark I. consists of: A tube (toughened steel); B tube; breech coil, triple (or quadruple) coil, trunnion ring and triple coil in front of the trunnions welded together; cascable.

Mark II. consists of: A tube (toughened steel); B tube;

Section I.

R.M.L. Ordnance (11-inch).

triple coil in front of trunnions; coiled breech piece; breech coil; double coil and a trunnion ring welded together; cascable.

The 11-inch gun was recommended in 1867 for trial in comparison with the 12-inch, in order "to determine what calibre and proportional length of bore were best adapted to a gun of from 23 to 25 tons weight." The question was decided in 1870 in favour of the smaller calibre.

These guns are examined after every 50 rounds.

RIFLING.

The rifling is on the Woolwich system with increasing twist. Depth of groove 0.2-inch.

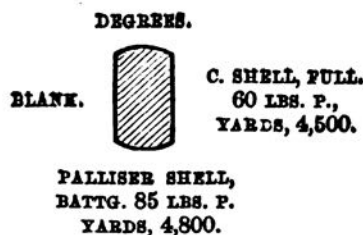
VENTING.

The gun is vented on the right side at an angle of 45° with vertical axis, the bush striking the bore at a distance of $\frac{1}{16}$ ths of the length of the cartridge from the bottom of the bore.

SIGHTING.

The gun is provided with six sights, viz., 2 tangent scales, one on each side, graduated up to 12° and furnished with deflection leaves.

The bar of the sight is four-sided and marked as follows:—

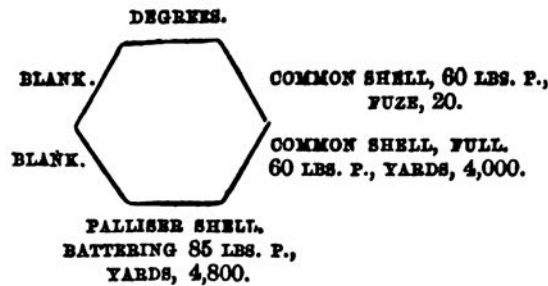


One centre hind sight. This is a short scale with deflection leaf on the head, graduated to $10\frac{1}{2}^\circ$, for use when the gun cannot be laid by the side sights, it works in a gun metal socket fixed in the gun, and is provided with a set screw, is six-sided, and marked as follows:

R.M.L. Ordnance (11-inch).

Section I.

MARK II.



The old pattern centre hind sight is graduated to 5° only and has no deflection leaf.

Two trunnion sights similar to those described for 10-inch gun, one centre foresight similar to the trunnion sight, but not interchangeable.

PROJECTILES, WITHOUT GAS CHECKS.

		lbs.	ozs.
Shot-case filled with 210 8-oz. sand shot, clay and sand		200	0
Shells	{ common, empty	506	4
	{ with 29½ lbs. bursting charge in bag	536	4
	{ Palliser empty	529	8
	{ with 6 lb. 7 oz. bursting charge in bag	536	2
	{ Shrapnel, filled with 378 4-oz., or 465 3¼-oz. sand shot, and 1 lb. 12 oz. bursting charge	531	6
Gas check, weight of		14	0

Case shot is used for close quarters against troops or boats.

Palliser shell are used against ironclads.

Common shell (which may also be fired with battering charge) are used against shipping.

CHARGES.

Battering	85 lbs. P or 70 lbs. R.L.G powder.
Full	60 lbs. P or 50 lbs. R.L.G powder.

11-INCH R.M.L. GUN.

Charge, 85 lbs. P. Projectile, with Gas-check, 547 lb.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1355	6962.0	202.94
500	1293	6339.5	184.79
1000	1235	5783.4	168.68
1500	1182	5297.7	154.42
2000	1134	4876.1	142.14
2500	1090	4505.1	131.8
3000	1052	4196.5	122.82

Section I.

R.M.L. Ordnance (11-inch and 12-inch).

FUZES.

Time 15-second M.L.O. for use with shrapnel shell.

Percussion Pettman General Service, for sea fronts, for use with common shell intended to burst on impact.

CARRIAGES. 11-INCH AND 12-INCH R.M.L. OF 25 TONS.

The carriage is similar to the 10-inch Mark I., but has an angle stay across the bottom plate. The brackets are the same thickness as in the latter carriage, and the rollers, together with the axles of the front rollers, are also the same. The bottom plate is 1 inch thick.

In the first 12-inch carriage manufactured, the eccentric axles of the rear rollers were made as in the 7-inch carriage and connected in the same manner by a bar. (This is altered when the platforms on which the carriages are mounted are fitted with traversing gear.) Such carriages were fitted with the capstan head elevating gear. They also had the Elswick compressor with nine plates; except the shafts all the parts being interchangeable with the same compressor in the 7-inch or 9-inch.

In the later carriages the rear rollers have an eccentric shaft $2\frac{1}{2}$ inches in diameter, and a bracket fitted with a treble block for the fall of the running back tackle.

ELEVATING GEAR.

Their elevating arrangement is the worm wheel and worm similar to the 9-inch, that is, with an intermediate pinion. The latter and the worm wheel pinion are each 5.9 inches in diameter, and the worm shaft is 2 inches in diameter and $43\frac{1}{2}$ inches long. These parts, and also the arcs and arc pinions are not interchangeable with those of the 9-inch, nor except the arc pinions with those of the 10-inch.

TABLE OF WEIGHTS, &C., OF CARRIAGES FOR 11-INCH OR 12-INCH R.M.L. GUNS OF 25 TONS.

Nature.	Weight.	Diameter of Rollers.	
		Front.	Rear.
12-inch R.M.L. single plate.	casemate	in. 12	in. 8
	.. fitted with N.P. elevating gear and buffer ..	12	8
11-inch or 12-inch R.M.L. double plate.	fitted for E.O.C. compressor O.P. elevating gear ..	12	8
	fitted for buffer O.P. elevating gear .. .. .	..	..
	fitted for buffer N.P. elevating gear .. .. .	..	..

R.M.L. Ordnance (11-inch and 12-inch).

Section I.

HYDRAULIC BUFFER.

The fitments for the hydraulic buffer are identical with those of the 10-inch carriage, described page 253, the diameter of the four piston holes, viz., 0·8-inch, being the same.

TRAVERSING PLATFORM FOR 11-INCH AND 12-INCH R.M.L. GUN OF 25 TONS.

Traversing platforms for 11-inch and 12-inch R.M.L. guns of 25 tons are of the "fish bellied" system, and are dwarf or casemate.

The platform is 15 feet in length and has a slope of 4°.

It is fitted with brackets on the side for the reception of the sponge, rammer and iron-pointed levers.

A water tank is attached to the rear of the right side of the platform for wetting the sponge head.

TABLE OF WEIGHTS, &C., OF PLATFORMS FOR 11-INCH OR 12-INCH R.M.L. GUNS OF 25 TONS.

Nature.	Weight.	Diameter of Trucks.	
		Front.	Rear.
12-inch R.M.L. casemate for single plate carriage }	cwts. qrs. 80 1	in. 7½	in. 10½
12-inch R.M.L. casemate fitted with buffer and traversing gear .. }	do. do. 102 0	..	..
11-inch or 12-inch { casemate fitted for E.O.C. compressor .. }	98 2*	10	13
ditto with buffer ..	110 0 (with gear)	..	..
R.M.L. dwarf "A," with buffer ..	139 1 "	18	24
double dwarf "C," with buffer ..	136 3 "	24	24
plate. dwarf "O," central ..	137 2 "	24	24
dwarf "D," with buffer ..	142 0 (estimated)	24	18

* Without traversing gear.

TRAVERSING AND RUNNING BACK GEAR 11-INCH AND 12-INCH R.M.L. GUNS OF 25 TONS.

The traversing gear consists of a combination of common tooth gearing, which acts directly on two of the four trucks of the platform, causing them to revolve and to traverse the platform right or left as desired. The gearing is set in motion by a winch handle placed at the rear or side of the platform.

The running back gear consists of part of the traversing gear combined with a revolving bollard and special block tackle.

Section I.

R.M.L. Ordnance (12-inch, 25 tons).

A clutch pinion is provided which, by means of a lever, is connected or disconnected with the truck pinions, by which means the part of the gear connected with the running back may be set in motion without acting on the trucks of the platform.

The same winch handle works both the traversing and running back gear.

RACERS, GRADUATED ARC, AND POINTER.

See pages 254, 255.

PRESERVATION OF SIGHTS AND FITTINGS.

See page 216.

12-INCH R.M.L. GUN OF 25 TONS.

DESCRIPTION.

Calibre .. ..	.. ..	12 inches.
Nominal Weight .. ..	.. ..	25 tons.
Preponderance .. ..	.. ..	6 cwt.
Length {	of bore	12 feet 1 inch.
	of rifling	10 feet 7 inches.
	total	15 feet 2½ inches.
Rifling {	grooves, number	9.
	spiral, increasing from	1 in 100 to 1 in 50.

DIFFERENT PATTERNS.

There are two patterns of this gun.

Of Mark I, there are only four in the service, known externally by having steps in front of the trunnion, and also at the breech. Their weight is 23½ tons, but by an order of 3rd July, 1868, to avoid confusion, it was approved that they should all bear the same designation, viz., "Ordnance Rifled M.L. 12-inch of 25 tons," this being the weight of the later patterns.

CONSTRUCTION.

Mark II. was introduced in 1866, the first gun made (No. 5) being exceptional in having a coiled iron tube, and also a solid forged breech piece. Externally they are known by the step at the breech. The number of 12-inch 25-ton guns, Mark II., constructed up to June, 1871, is nine.

Two other guns are of the same construction as the 11-inch gun, Mark I., but they do not form a distinct pattern, and are known by their Numbers (20 and 21).

R.M.L. Ordnance (12-inch, 25 tons).

Section I.

Mark I. consists of—A tube (toughened steel); breech piece; B tube; trunnion ring; 7 coils; cascable.

Mark II. consists of—A tube (toughened steel); B tube; triple coil in front of trunnions; coiled breech piece; breech coil, double coil, and trunnion ring welded together; cascable.

This gun is examined after every 60 rounds.

RIFLING.

The rifling is on the "Woolwich system," with increasing twist. Depth of groove 0.2 inch.

VENTING.

The gun is vented on the right side, at an angle of 45° with vertical axis, the bush striking the bore at a distance of $\frac{1}{10}$ ths of the length of the cartridge from the bottom of the bore.

SIGHTING.

The gun is provided with six sights, viz., two tangent scales, one on each side, graduated up to 12° , and furnished with deflection leaves.

MARK II.

DEGREES.

C. SHELL, BATTG. 85 LBS. P.
YARDS, 4,800, FUZE 32.



C. SHELL, FULL 55 LBS. P.
FUZE 24, YARDS, 4,000.

PALLISER SHOT OR SHELL,
BATTG. 85 LBS. P., YARDS, 4,800.

One centre hind-sight. Mark III. This is a short scale with deflection leaf on head graduated to $10\frac{1}{2}^\circ$, for use when the gun cannot be laid by the side sights. It works in a gun-metal socket fixed in the gun, and is provided with a set screw, is six-sided, and marked as follows:—

MARK III.

DEGREES.

BLANK

BLANK



BLANK

COMMON SHELL FULL,
55 LBS. P., YARDS, 4,000.

PALLISER SHOT OR SHELL,
BATTG. 85 LBS. P.,
YARDS, 4,800.

Section I.

R.M.L. Ordnance (12-inch, 25 tons).

Marks I. and II. are graduated to 5° only, and have no deflection leaf.

Two trunnion sights similar to those described for 10-inch gun, one centre foresight, similar to the trunnion sights.

PROJECTILES WITHOUT GAS-CHECKS.

		Weight. lbs. oz.
Shot	case, filled with 258 8-oz. sand shot, clay, and sand	246 0
	Palliser, empty	596 4
	„ filled with 7 lb. 12 oz. bursting charge in bag	604 0
Shells	common, empty	459 8
	with 37½ lbs. bursting charge in bag	497 7
	Palliser, empty	586 4
	with 14 lbs. bursting charge in bag	600 7
	Shrapnel, filled with 276 4-oz., or 339 ¾-oz. sand shot, and 1 lb. 15 oz. bursting charge	496 12
	Gas checks, weight of	15 0

Palliser shot or shell are used against ironclads.

Common shell (which may also be fired with battering charge) are used against shipping.

Case shot for close quarters against troops or boats.

CHARGES.

Battering	85 lbs. P or 67 lbs. R.L.G.
Full	55 lbs. P or 50 lbs. R.L.G.

12-INCH R.M.L. GUN OF 25 TONS.

Charge, 85 lbs. P. Projectile, with Gas-check, 614½ lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1288	7066·7	188·7
500	1228	6423·7	171·54
1000	1172	5851·2	156·25
1500	1123	5372·1	143·46
2000	1078	4950·2	432·19
2500	1040	4607·4	123·03
3000	1009	4336·8	115·81

FUZES.

Time 15-seconds M.L.O. for use with shrapnel shell.

Percussion, Pettman's General Service, for sea fronts, for use with common shell intended to burst on impact.

R.M.L. Ordnance (12-inch, 35 tons.)

Section I.

CARRIAGES, PLATFORMS, FITTINGS, &c.

See pages 260, 261.

12-INCH R.M.L. GUN OF 35 TONS.

DESCRIPTION.

Calibre..	..	..	..	12 inches,
Nominal Weight	..	..	..	35 tons.
Preponderance..	..	..	..	1 cwt. 2 qrs.
Length	{ of bore	..	..	13 feet 6.5 inches.
	{ of rifling	..	..	11 feet 3 inches.
	{ total	..	..	16 feet 3 inches.
Rifling,	{ grooves, number	..	..	9.
	{ spiral, increasing from 0 to 1 in 35	..	..	calibres.

PATTERN.

There is only one pattern of this gun.

CONSTRUCTION.

It consists of—A tube (toughened steel); B tube; triple coil in front of the trunnions; coiled breech piece; breech coil (double coil, and a trunnion ring welded together), cascable.

Only fifteen have been made, of which 5 only are mounted for coast defence.

The gun is examined after every 50 rounds.

RIFLING.

The rifling is on the Woolwich system, with increasing twist.

VENTING.

The gun is vented (for L.S.) on the right side, at an angle of 45° with vertical axis, the bush striking the bore at a distance of $\frac{1}{16}$ ths of the length of the cartridge from the bottom of the bore.

SIGHTING.

The gun is provided with six sights, viz., 2 tangent scales, one on each side, graduated up to 10°, and furnished with deflection leaves. The bar of the sight is four-sided, and marked as follows :—

(A. M.)

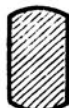
8

Section I.

R.M.L. Ordnance (12-inch, 35 tons).

DEGREES.

BLANK.



COMMON SHELL, FULL.
85 LBS. P.
YARDS, 4,500.

PALLISER SHOT OR SHELL BATTERING.
100 LBS. P. YARDS, 4,800.

One centre hind-sight, viz., a third tangent sight, with steel bar.

PROJECTILES WITHOUT GAS CHECKS.

		Weight.	
		lbs.	oz.
Shot, case, filled with 258 8-oz. sand shot, clay, and sand		246	0
Shells {	common, empty	575	3
	filled with 40 lbs. bursting charge in bag ..	615	8
	Palliser, empty	688	5
	filled with 9 lb. 14 oz. bursting charge in bag	698	5
	Shrapnel, filled with 368 4-oz. or 453 3¼-oz. sand shot and 1 lb. 15 oz. bursting charge..	612	5
Gas-check, weight of		15	0

Case shot is used for close quarters against troops or boats.

Palliser shell against ironclads.

Common shell (which may also be fired with battering charges) are used against shipping.

CHARGES.

Battering ..	110 lbs. P.
Full	85 lbs. P or 67 lbs. R.L.G.

12-INCH R.M.L. GUN OF 35 TONS.

Charge, 110 lbs. P. Projectile, with Gas-check, 714 lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1364	9208.6	245.9
500	1306	8442.1	225.44
1000	1253	7770.8	207.51
1500	1203	7163.0	191.28
2000	1157	6625.7	176.93
2500	1115	6153.4	164.32
3000	1077	5741.1	153.31

FUZES.

Time, 15-seconds, M.L.O. for use with shrapnel shell.

Percussion, Pettman General Service, for sea fronts, for use with common shell intended to burst on impact.

R.M.L. Ordnance (12-inch, 35 tons).

Section I.

CARRIAGE.

	Weight. cwt. qrs.	Diameter of Rollers.	
		Front.	Rear.
12-inch R.M.L. of 35 tons } fitted for buffer .. }	119 0	13 inches	12 inches

The carriage is of "double plate" construction upon Captain Scott's principle, namely, with low brackets, and a well between them.

The brackets are supported by three transoms, and each is further strengthened by a knee stay. The transoms and stays extend below the brackets, to form the well of the carriage, which is completed by a bottom plate riveted underneath.

The latter does not extend to the rear transom, in order to give access there to the interior of the carriage for placing skidding when the gun is being mounted or dismounted. The eccentric axles of the rear rollers are worked by a hydraulic jack, its ram being keyed to a crank upon the shaft.

ELEVATING GEAR.

The elevating gear consists of an arc, secured to the gun top and bottom on the right side, worked by a metal hand wheel outside the bracket of the carriage, through a train of wheels and pinions. A clamping arrangement is attached.

To attach the carriage to the endless chains of the running back (or up) gear of the platform, it is fitted with nipping gear (Scott's). This consists of a sprocket plate (or plate with projecting teeth) on each side (one for each chain), connected by a cross shaft inside the well of the carriage, which plates are lowered when it is desired that their teeth may catch in the chains, by means of a link and eccentric worked by a lever outside the carriage on the left. The chains pass through brackets beneath the carriage, which hold them up to the sprocket plates when the latter are forced down. A counter weight is attached to their cross shaft, to keep the sprocket plates up and clear of the chains when not in use, and a pawl to the side of the carriage to secure the lever.

The carriage is fitted with the usual holding down clips, buffer bracket, &c.

HYDRAULIC BUFFER.

The diameter of the holes in the piston is .65 inch.

TRAVERSING PLATFORM DWARF C PIVOT.

This platform is the same in construction as the casemate platform for 38-ton gun, hereafter described, but raised sufficiently high to admit of the gun firing over a 4 foot 3 inch parapet.

(A. M.)

s 2

Section I.

R.M.L. Ordnance (10, 11, and 12-inch).

The traversing and running back gear differs from the case-mate arrangement for the 38-ton gun in the sprocket wheel shaft being placed to the rear of the traversing cross shaft, and in there being two clutches instead of one upon latter, which are worked, through connecting rods, by the same lever. A wooden step is attached to each side of the platform, and an iron one in rear.

DRILL WITH 10-INCH, 11-INCH, AND 12-INCH R.M.L.
GUNS MOUNTED IN CASEMATES OR OPEN
SHIELD BATTERIES.

The Detachment consists of 15 Nos., and falls in two deep.

TO TELL OFF.

*Officer.**No. 1.**Tell off.*

At "*Tell off*," No. 1 (who is on the left of the front rank) takes a pace to his front, turns to his right, and numbers himself 1; the right hand man of the rear rank numbers 2; the right hand man front rank 3; the second man from the right of the rear rank, 4; the man in his front 5, and so on. After the detachment is told off, No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery and halted in line facing the shield, and to the left rear of the platform. The detachment is now in the position of "detachment rear."

TO TAKE POST UNDER COVER.

*Officer.**No. 1.**Take post under cover.*

Right turn.
Double march.

The detachment stepping off, wheels to its left at the left corner of the platform, the front rank filing to the left of the gun, the rear rank to the right, 2 and 3 halting close to the shield, and near the port; 4 and 5 forming upon their right and left; 12 and 11 upon the right and left of 4 and 5, the whole turning to the right-about together. No. 1 follows in rear of the detachment keeping under cover as much as possible; 6 goes to the head of the cartridge lift; 7 and 9 to the head of the shell lift; 8 and 14 to the cartridge store; 10, 13, and 15 to the shell store.

R.M.L. Ordnance (10, 11, and 12-inch).

Section I.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, and lays.

No. 2 searches, sponges, steadies and guides projectile in raising, rams home, runs up, and elevates.

No. 3 searches, sponges, loads, hooks and unhooks hoisting tackle, steadies and guides projectile in raising, uncaps fuze when in the bore, attends to "port bar," rams home, runs up and elevates.

No. 4 attends to side-arms and supplies them to 2, rams home, and traverses.

No. 5 supplies wedge wads, raises projectile, rams home, attends to snatch block, and traverses.

No. 6 supplies cartridges to 3, and rams home.

No. 7 attends to fuzes, brings up projectile, raises it, and rams it home.

No. 8 attends to cartridge store, and serves out cartridges.

No. 9 assists 7, raises projectile, and removes empty barrow.

No. 10 attends to shell store, issues shell, tubes, and fuzes.

No. 11 raises projectile, assists 6 with cartridge (if required), rams home, attends to mantlet, and traverses (if required).

No. 12 rams home, attends to vent and mantlet, traverses (if required), makes ready and fires.

Nos. 13 and 15 at the shell store.

No. 14 at the cartridge store.

N.B.—Nos. 1, 6, and 12 assist to raise projectile when necessary.

TO PREPARE FOR ACTION.

<u>Officer.</u>	<u>No. 1.</u>
<i>Prepare for action.</i>	<i>Prepare for action.</i>
	<i>Examine gun.</i>

"*Prepare for action.*"—No. 1 provides and fixes sights.

No. 2, iron pointed lever, elevating wheel, and assists 4 with side-arms.

No. 3, iron pointed lever, elevating wheel, and hoisting tackle (10-inch double and single, 11-inch and 12-inch double and treble blocks). He removes the muzzle tampon.

No. 4, side-arms.

No. 5, wedge wads, traversing handle (or handles), and tackle for running back.

No. 6 (zinc cartridge cylinder, and dummy cartridge for drill purposes), bucket filled and brush, and two wood cartridge cylinder bearers for use if required.

No. 7, fuzes, fuze and shell implements, and two straps for projectile; he obtains the fuze boxes from 10, satisfying himself as to the correctness of fuzes and fuze implements.

Section I.

R.M.L. Ordnance (10, 11, and 12-inch).

No. 8 goes to the cartridge store and prepares to issue cartridges.

No. 9, transporting barrow and a brush.

No. 10 goes to the shell store, and prepares to issue shells, tubes, and fuzes; he examines the shells carefully, cleaning them if necessary, and removing burrs from studs; he loosens the fuze hole plugs of shells that will be first issued.

No. 11 assists 2 and 4 and brings up rammer ropes when fitted with spring clips.

No. 12, tubes in box, lanyard, pricker and vent server.

Nos. 13 and 15 go to the shell store.

No. 14 to the cartridge store.

Nos. 8 and 10 satisfy themselves that the lamps in the ammunition stores are burning brightly.

Nos. 13 and 14 that the hoisting gear at the shell and cartridge lifts work easily.

Any irregularity in these respects should be at once reported to No. 1.

The stores having been brought up, or found correct, No. 1 will satisfy himself that the foresights fit properly on the gun, the deflection leaves of the hind sights work easily, and that the clip plates are secured to the carriage; he ascertains that the hydraulic buffer is filled with the proper amount of oil, and that the racers are swept; he receives reports from the Nos. responsible of any irregularity or deficiency in connection with the different parts of the gun, carriage, platform, stores, or as regards the ammunition stores, lifts, &c.

Nos. 2 and 4 place the sponge and rammer in the supports on the right side of the platform, the shell extractor and wadhook in rear so as not to interfere with the working of any of the guns in the battery, and convenient for those for which intended.

No. 2 sees that the elevating gear, 4 that the traversing gear is oiled and in good working order; 2 and 3 place the iron pointed levers in their supports on the platform.

No. 3 examines the bore to see the grooves are free from grit, &c., secures the hoisting tackle to the loading bar, overhauling it until the lower block is at a convenient height for hooking to the strap on the projectile. The lower block should then be hooked back to a loop on the left mantlet to keep the tackle out of the way until required.

No. 5 reeves the running back tackle.

No. 6 supplies the sponge trough with water from the bucket, and places the latter clear of the working of the gun.

No. 11 coils down the rammer ropes either side of the gun and sees that the mantlets work easily.

No. 12 places the pricker in the loop on the side of the carriage, examines the vent server and places it in the vent, the loop of the vent server lanyard over one of the sights; straps the tube box round his waist on the right side, coils up the lanyard and passes the bight of it under the tube box strap; fills his box with friction tubes which he procures from 10.

R.M.L. Ordnance (10, 11, and 12-inch).

Section I.

"*Examine gun*;" 12 drifts the vent, and replaces the vent server, 2 and 3 search the gun after the pricker is withdrawn, 2 supplying himself with the wadhook and replacing it; 11 and 12 elevate until the gun is in a convenient position for loading.

TO LOAD.

<i>Officer.</i>	<i>No. 1.</i>
<i>Range</i> —yards.	<i>With</i> —load.
<i>With</i> —load.	

"*Load*," No. 1 gives 7 the nature of shell (and length of fuze required), and adjusts the tangent sight.

2 moves into position for sponging, receives the sponge from 4, and, assisted by 3, sponges the gun, being careful to observe that the vent server is in the vent. He returns the sponge to 4, and, with 3, steadies the projectile in raising and guiding it into the bore. He then receives the rammer (with right rammer rope attached) from 4, and, assisted by 3, steadies the stave, whilst the cartridge and projectile are being rammed home. The rammer ropes being manned by 4, 6, and 12 on the right 5, 7, and 11, on the left of the gun. Should "*Not home*" be given by 2, they again stand to the ropes and force the charge home. At "*Home*" they go under cover. 2 and 3 detach the rammer ropes (if fitted with spring clips), hand them to 11 and 12, spring the rammer, 3 inserts a wedge wad, which is pressed steadily home by 2 and 3, and jammed under the head of the projectile by two smart taps; they spring the rammer (2 handing it to 4), and go under cover.

3 moves into position, and having fixed the port bar and assisted 2 to sponge, slews to his right, withdraws the cartridge from the cylinder, placing it on his right shoulder, choke to his front; he then turns left about until his back is towards the muzzle and slides the cartridge from off his shoulder into the bore. The projectile is now brought up on the barrow with strap ready fixed; 3 standing clear, close to the front of the platform, 5 casts loose the lower block of the hoisting tackle; 3 hooks it into the strap, and gives "*Hoist away*," and with 2 steadies and guides the projectile, which is raised by 5, 7, 9, and 11, manning the running end of the fall; 3 gives "*High enough*," "*Ease off*," and, having with 2 forced the projectile into the bore, casts loose the strap, replacing it in the barrow, and uncaps the fuze. The barrow may be pushed clear by 3 before hoisting; 3 now hooks on the left hand rammer rope which he receives from 11, and the charge and wedge wad are rammed home in succession, the rammer sprung as before detailed and the port bar unshipped by 3.

4 hands the sponge to 2 and receives it back from him; he hands him the rammer as soon as the projectile is in the bore and mans the rammer rope. When the projectile and wedge wad have been sent home, he receives the rammer back from 2, and replaces it.

Section I.

R. M. L. Ordnance (10, 11, and 12-inch).

5, as soon as the cartridge is in the bore, casts loose the lower block of the hoisting tackle, attends to snatch block, mans the fall in raising the projectile, and the rammer rope in ramming home. When the charge is home he supplies 3 with a wedge wad, and hooks the lower block of the hoisting tackle to the loop on the left mantlet.

6, after supplying 3 with cartridge, which he brings up on his shoulder, lid to the rear, mans the rammer rope on the right of the gun.

7 brings up projectile in barrow with strap on, having previously, when necessary, adjusted the fuze according to No. 1's directions, assist to raise and ram it home.

8 issues a cartridge to 6.

9 assists 7 to prepare, bring up and raise projectile, removes barrow and strap.

10 issues shell.

11 assists 3 with cartridge if required, raises and rams home projectile, and attends to the left mantlet and left rammer rope.

12 rams home and attends to right mantlet and right rammer rope.

13 and 15 work the shell lift.

14, the cartridge lift.

N.B.—When rammer ropes, fitted with “spring clips,” are not in use, they are coiled down between the racers, close to the piers by 11 and 12.

TO RUN UP.

Officer.

No. 1.

Run up.
Halt.

“Run up,” 2 and 3 put the iron pointed levers into the sockets and bear down; should it be observed that the gun is running up too rapidly 2 and 3 raise their levers and check it.

When the gun is in position No. 1 gives the word “Halt.” 2 and 3 raise the levers till the sockets touch the stop plates; they then replace them. No. 12 hooks a tube to the lanyard; 11 and 12 close the mantlets.

TO LAY THE GUN. (See SECTION IV., PAGE 336).

Officer.

No. 1.

Elevate. Halt.
Depress.
Trail right. Halt.
Trail left.

2 or 3 works the elevating gear, but if it is found that the gear works stiffly, both Nos. can be employed, provided they work at

R.M.L. Ordnance (10, 11, and 12-inch).

Section I.

the same speed, 4 and 5 the traversing handles. Should extreme right or left be given 11 and 12 assist 4 and 5. Should no order to fire be given when the gun is laid, No. 1 will give the word "*Under cover.*"

TO MAKE READY AND FIRE.

<i>Officer.</i>	<i>No. 1.</i>
<i>Fire—rounds.</i>	<i>No.—Ready.</i>
	<i>No.—Fire.</i>

At "*Ready*" the gun numbers stand clear. No. 12 places the tube in the vent, passes the lanyard through the rear eye bolt of the carriage and stands ready to fire, facing the gun. At "*Fire*" he draws the lanyard strongly towards him without a jerk; he drifts the vent, replaces the vent server and pricker and coils up the lanyard, placing it under his belt.

11 and 12, assisted by 4 and 5 if necessary, will, as soon as the gun has been fired, at once traverse it back to a position convenient for loading, without any word of command.

TO RUN BACK AND UNLOAD.

<i>Officer.</i>	<i>No. 1.</i>
	<i>Run back. Halt.</i>
	<i>Unload.</i>

At "*Run back*" No. 1 disconnects the traversing pinions by shifting and keying up the handle. He follows up the right front truck with a scotch.

2 and 3 apply their levers and bear down; 4 and 5 fix the small pawls; 2 and 3 then withdraw their levers and replace them; 11 and 12 connect running back tackle; 6 and 7 assisting to overhaul; 4, 5, 11, and 12 man the winch handle; 6 and 7 holding on to the fall; No. 1 gives "*Heave round,*" and, as soon as the gun is back, "*Halt,*" when 2 and 3 apply their levers and bear down; 4 and 5 release the small pawls; 11 and 12 remove the tackle.

No. 1 then places the traversing apparatus in gear, and keys up.

The gun is unloaded by the same numbers who loaded it.

TO CEASE FIRING AND REPLACE STORES.

<i>Officer.</i>	<i>No. 1.</i>
<i>Cease firing.</i>	<i>Depress. Halt.</i>
<i>Replace Stores.</i>	<i>Replace Store.</i>

The gun is depressed, and the stores are replaced by the numbers who brought them up.

Section I.

R.M.L. Ordnance (10, 11, and 12-inch).

TO FORM DETACHMENT REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment Rear.</i>	<i>Outwards turn.</i>
	<i>Double march.</i>
	<i>Halt.</i>
	<i>Front.</i>

"*Detachment rear*," No. 1 doubles to the left rear of the platform, faces to the left and gives the order "*Outwards turn*," 2, 4 and 12 turn to their left, 3, 5 and 11 to their right, "*Double March*," 12 and 11, followed by 4, 5, 2 and 3, wheel to the right and left, and when clear of the platform to the right, and round No. 1's left shoulder; 6, 7 and the remaining numbers coming up into their places; when 2 and 3 have passed him, No. 1 gives "*Halt*," "*Front*," and changes his flank by the rear.

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change rounds.</i>	<i>Change rounds.</i>

In changing rounds 2 becomes 4; 4, 1; 1, 15; 15, 14; 14, 13; 13, 12; 12, 11; 11, 10; 10, 9; 9, 8; 8, 7; 7, 6; 6, 5; 5, 3; and 3, 2.

SERVICE OF GUNS MOUNTED ON TURNTABLES.

The method of serving a 10-inch, 11-inch, or 12-inch R.M.L. gun mounted on a turntable is the same as detailed for guns on traversing platforms.

To shift from one port to another at "*Turntable right*" (or "*left*") 2, 3, and 6 attend to the catches, 4, 5, 11, and 12 to the winch of the table.

The turntable is for moving a gun from one port to another, and not for traversing.

SERVICE OF 10-INCH, 11-INCH, AND 12-INCH GUNS IN BARBETTE BATTERIES (WITH SUNKEN WAYS).

The guns are fitted with muzzle derricks and supplied with loading stages.

The running end of the fall of hoisting tackle is led through an ordinary single 8-inch Bothway block, which is hooked into a permanent eye let into the wall of the parapet. Two snatch blocks are hooked to the loops or eyes on the derrick, and the bell ropes of the rammers are passed through them. The snatch blocks are hooked for "*loading*" by 2 and 3, unhooked by them

R.M.L. Ordnance (10-inch).**Section I.**

when the wedge wad has been rammed home, and laid down with the rammer ropes when not in use by 11 and 12 who attend to them. The upper block of the hoisting tackle should be moused with spunyarn. The service of the guns is the same as for those mounted in casemates and behind shields, with the following exceptions:—

"General duties."—5 attends to muzzle derrick, 7 and 9 attend to loading stage.

"Prepare for action."—5, an 8-inch single Bothway block, 11, two 4-inch snatch blocks, which he hooks on to the derrick, 9 tackle for hoisting projectiles on to loading stage.

"To load."—5, as soon as the cartridge is in the bore, raises the derrick and overhauls the tackle; after supplying 3 with a wad, he rounds in the tackle and throws back the derrick; 7 and 9 (assisted by 13 and 15) having placed a projectile on the loading stage, run it under the muzzle of the gun, and after the rammer has been withdrawn from the bore, run the stage back to its former position.

If no crane or derrick is available for lifting projectiles on to the loading stage, they can be rolled on on a plank.

The paragraphs relating to portbar, mantlets and transporting barrow do not apply to this drill, the barrow being required for conveying projectile to loading stage only.

N.B.—For guns mounted "en barbette" without sunken ways, a transporting barrow is used for conveyance of projectile to the muzzle of the gun, instead of a loading stage.

DRILL WITH 10-INCH R.M.L. GUN MOUNTED ON SMALL PORT CARRIAGE.

RAISING THE GUN BY RAM.

Prepare to raise the Gun.

Raise the Gun.

Halt.

Nos. 2, 3, 4 and 5 man the pump lever handles of the ram; 2 and 4 on the right, 3 and 5 on the left; 11 and 12 (assisted, if necessary, by 6 and 7) man the winch handles of the quick motion screw for following up—6 and 12 on right, 7 and 11 on left.

RAISING THE GUN BY SCREW LIFT.

In the event of the failure of the hydraulic ram, the slow motion screw lift must be worked. This will require 4 men on each handle, to be relieved when necessary by other men of the detachment and supernumeraries.

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R.M.L. Ordnance (12·5-inch).

N.B.—No. 1 attends to the release valve, and must be careful after each change of position of the gun, and *Before firing*, that the release valve is open until the gun rests on the trunnion blocks, when it should be again closed.

The detachment consists of 15 Nos. The drill is the same as for similar guns mounted on casemate traversing platforms with the following exceptions:—

The sponge and rammer being slung from the roof 12 (in addition to his other duties) assists 4 to supply and replace them.

No. 1 attends to the release valve.

12·5-INCH GUN OF 38 TONS.

DESCRIPTION.

Calibre	12·5 inches.
Nominal weight ..	38 tons.
Preponderance ..	Nil.
Length { of bore ..	16 feet 6 inches.
{ of rifling ..	14 feet 2½ inches.
{ total ..	19 feet 2 inches.

PATTERN AND CONSTRUCTION.

Rifling { grooves, number .. 9
 { spiral increasing from 0 to 1 in 35 calibres.

There is only one pattern of this gun, which in construction exactly resembles the 35-ton gun, from which it differs in dimensions only.

RIFLING.

The rifling is on the Woolwich system with increasing twist.

VENTING.

Similar to the 35-ton gun.

SIGHTING.

Similar to the 35-ton gun.

R.M.L. Ordnance (12·5-inch).

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PROJECTILES (WITHOUT GAS CHECKS).

		Weight, lbs. oz.	
Shot, case, filled with 8-oz. sand shot, clay, and sand]			
Shells	common, empty	780	8
	with bursting charge in bag	807	8
	Palliser, empty	790	8
	with 11 lbs 8 oz. bursting charge in bag	802	4
	Shrapnel, filled with 284 8-oz. sand shot and 2 lbs. 7 oz. bursting charge	806	0
Gas check	17	3	

Case shot is used for close quarters against troops or boats.
Palliser shell against ironclads.
Common shell are used against shipping.

CHARGE.

160 lbs. P.₃, made up in 2 bags of 80 lbs. each.

12·5-INCH R.M.L. GUN.

Charge, 160 lbs. P.₃. Projectile, with Gas-check, 818 lbs.

Range in Yards.	Velocity.	Energy.	Energy per inch of Shell's Circumference.
	feet per second.	foot tons.	foot tons.
0	1463	12,137·0	311·56
500	1403	11,162·0	286·53
1000	1346	10,274·0	263·72
1500	1293	9480·2	243·36
2000	1243	8761·2	224·90
2500	1196	8111·2	208·21
3000	1153	7538·4	193·51

FUZES.

Time—15 seconds, M.L.O., for use with shrapnel shell.

Percussion—Pettman general service, for sea fronts, for common shell, intended to burst on impact.

CARRIAGE.

Sliding carriages for 12·5-inch guns are of the double plate construction, the brackets are formed of two plates of wrought iron riveted to a framework of cast iron fitted between them. They are fitted for hydraulic buffers.

The carriages are employed both as dwarf and casemate, the difference in height being given by the platform.

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R.M.L. Ordnance (12·5-inch).

Each carriage consists of:—

2 brackets.	2 rear rollers, with eccentric shaft.
1 front transom.	1 jack, hydraulic, 10 tons, complete.
1 centre transom.	2 front clip plates.
1 rear transom.	3 compressor plates with pins and keys.
1 bottom plate, with plates, angle, and connecting.	Elevating gear.
2 stays, knee.	Nipping gear.
2 capsquares, with keys.	
1 step, rear.	
2 front rollers, with axles and $\frac{1}{2}$ -inch split keys.	

The capsquares are interchangeable and reversible on both sides of the carriage.

The clip plates prevent the carriage from jumping up when the gun is fired. They are fitted one on each side through slots cut in the angle plates connecting the bottom to the brackets, and secured each by one bolt through the bottom, passing under the upper flange of the platform girders. Before the carriage can be dismounted from the platform the clip plates must be removed.

The casemate carriage and platform will fire over a 3-feet 2-inch genouillère, the height of the axis of gun above the top surface of racers is 4 feet 11½ inches.

The dwarf carriage and platform will fire over a 4-feet 3-inch parapet, the height of the axis of the gun being 6 feet 0½ inch above the top surface of racers (outer edge).

The carriage allows of 10° elevation and 5° depression. Its weight is 113½ cwt.

In order to preserve the carriages in a proper working condition, the axles, spindles, pinions, &c., and also their bearings, must be kept clear of clotted oil and rust, and be well lubricated.

In putting the gear on a carriage, should a screw go very tight, it must be withdrawn and examined, and if it is found that the bearing or screw has been indented, the burr must be carefully removed with a file.

ELEVATING GEAR.

This consists of a train of wheels and pinions, an arc, and clamping arrangement, fixed on the right bracket.

The gear is worked by a hand wheel, and the power is transmitted through the pinions and wheels to the arc, which is secured to the gun at top and bottom. The clamping arrangement consists of a cramp, two jamming blocks and a screw with lever handle. The screw, on being tightened, presses the jamming block against the sides of the arc and clamps it. The outside of the arc is graduated with black lines representing intervals of 10 minutes,

R.M.L. Ordnance (12·5-inch).**Section I.**

and a reader or pointer is fixed on the bracket of the clamping arrangement, with its edge bevelled, and marked so that the elevation or depression can be read to 2 minutes.

NIPPING GEAR.

This consists of a sprocket plate (or plate fitted with projecting teeth) on each side, connected by a short cross shaft, with counter-weight; the plates are lowered when it is desired that their teeth may catch in the running-in-and-out chains, by means of a link and eccentric worked by a lever outside the left bracket.

The chains pass through brackets beneath the carriage which hold them up to the sprocket plates when the latter are forced down.

COMPRESSOR STOP.

Three plates are suspended under the carriage in such a position that they will become jammed by the plates of the platform, and prevent the carriage and gun running out after the recoil.

REAR ROLLERS, ECCENTRIC SHAFT.

The eccentric shaft of the rear rollers is worked by a hydraulic jack. The jack is fixed upon the left of the carriage inside the bracket by a projecting arm cast on the cistern, the ram being attached to a crank on the eccentric shaft.

REAR ROLLER, HYDRAULIC JACK.

Consists of a double action jack, lifting the rear of the carriage by either the forward or backward action of the lever. The lowering, or release valve is internal; when required to "lower," the lever is forced as far to the rear as possible, this allows the liquid to pass back to the cistern. Care must be taken in pumping not to carry the lever too far back to the rear, or lowering will commence.

NOTE.—In some of the first carriages issued the release valve was external.

TRAVERSING PLATFORMS.

Traversing platforms for 12·5-inch guns are constructed of wrought iron, on what is known as the "fish-bellied" system, are dwarf, or casemate, and allow of 6 feet recoil.

7 FEET RECOIL.

NOTE.—Some casemate platforms are made 1 foot longer, to give 7 feet recoil; they are fitted with a hydraulic buffer 7 inches longer; the front trucks of all casemate platforms are made of steel.

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R.M.L. Ordnance (12'5-inch).

WEIGHTS.

The weights of platforms, and diameters of the trucks used with each nature of platform and pivot, are as follows:—

Pivot.	DIAMETER OF TRUCKS.		Average Weight with Buffer and Gear.
	Front.	Rear.	
	inches.	inches.	cwt.
Casemate A	13	18	165½
Dwarf { C	24	24	193½
{ D	24	18	189½

HYDRAULIC BUFFER.

The object of using the buffer is to reduce the recoil of the carriage within the desired limits, which is accomplished as follows:—

The cylinder being rigidly fixed to the rear of the platform, and the end of the piston rod being fixed to the front of the carriage; when the latter is run up the piston rod is drawn out of the cylinder nearly its full length, and the piston drawn to the front end of the cylinder the oil passing to the back of the piston. As the carriage recoils it forces the piston rod with the piston up the cylinder, the resistance to its passage by the oil checking the recoil; the oil passes from the rear to the front of the piston through the holes in it, therefore the size of the holes is regulated by the velocity of the recoil; the larger the charge, the smaller the holes must be. The resistance offered by the oil increases with the velocity of the piston, and *vice versa*.

The cylinder not being entirely filled with oil, the air in the unfilled space acts as an elastic buffer.

The buffer is of a special strengthened pattern, with wrought iron caps, the piston rod is 3·5 inches diameter.

Four holes, 0·55 inch in diameter, are drilled in the piston, to allow of the passage of the oil.

FILLING CYLINDER (DIRECTIONS).

To fill the cylinder with oil, run the carriage up to the stops, take out the screw plug, and rest the gallon measure in the hole, turn off the cock and fill the measure with mineral oil to the gallon mark, then turn the cock and allow the oil to flow into the cylinder, repeat the operation until the required quantity is run in.

The greatest quantity used should not exceed 9 gallons, which, with the carriage run out, will be 3·125 inches deep at the filling hole; this depth may easily be tested with a slip of wood; oil is

R.M.L. Ordnance (12·5-inch).**Section I.**

withdrawn by means of the front cock, air being let into the cylinder at the same time by removal of the rear plug.

NOTE.—The hydraulic buffer for platforms allowing 7 feet recoil differs in following dimensions :—

Holes in piston.. ..	0·6-inch diameter.
Contents	10 gallons.
Depth of oil at filling hole ..	3 inches.

NOTE.—In the casemate platform the front cock is connected to the front of the buffer by a pipe, and is fixed to the left side.

REMOVAL OF BUFFER.

When not required for use, the buffer may be removed and placed in store, the oil being run out; though if required for occasional use it may be left filled and periodically examined.

SPANNERS.

A spanner for loosening or tightening the packing gland of the buffer will be issued in the proportion of one per work or battery; a double-headed spanner for the purpose of removing the screw plug and turning or tightening the cock is supplied with each buffer, and McMahon's spanner is used for screwing and unscrewing the nuts and collars.

TRAVERSING GEAR.

The traversing gear consists of a combination of common tooth gearing which acts directly on a toothed rack fixed in the floor of the work, to traverse the platform right, or left, as desired. The gearing is set in motion by a winch handle placed on each side of the platform.

RUNNING-BACK GEAR. FRICTION CLUTCH.

The running-back gear consists of part of the traversing gear, combined with two endless chains supported on wheels, at the front plain, and revolving in forks fitted with nuts for tightening the chains when required, at the rear sprocket, and keyed on a shaft driven by the gear. It is provided with a friction clutch which is worked by a lever moved by a screw and hand wheel on the left side, for the purpose of connecting or disconnecting, as the case may be, either the traversing or running-back gear with the winch handles.

The same winch handles thus work both the traversing and running-back gear.

INDICATOR.

On the screw shaft behind the hand wheel is fixed a disc having a spiral (or involute) groove cut on the inner face, which moves a
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R.M.L. Ordnance 12.5-inch).

pointer sliding in a bracket fixed to the side of the platform; this bracket is marked with the letters R. O. T., forming an indicator to register the position of the cone clutch, respectively, (1) for running-in-or-out, (2) central, or out of gear, and (3) for traversing; thus, when the hand wheel is turned to the left (or towards the front of the platform), the spiral groove in the disc, as it revolves with the hand wheel, lowers the pointer to the position marked T, and the cone clutch is engaged in the recess of the bevel pinion in the position for traversing.

COMPRESSOR STOP.

A compressor, consisting of five plates, an adjusting screw, and a compressing screw, with lever and counterweight, is fitted on the rear flange plate of the platform, and comes into action when the carriage has recoiled 5 feet 2 inches, by jamming the plates of the carriage. To "release the compressor" the lever with counterweight on right side is raised and held until the carriage has moved clear. To "adjust the compressor" the screw on the inside bracket is set up or loosened, as required.

FRONT BUFFER STOP.

This is fixed at the front of the platform, to control the running-up, and consists of an angle iron secured to the front plate, a block of wood secured to the angle iron, and six india-rubber rings, with spindles, secured in the above angle iron and wood by means of split keys.

REAR BUFFER STOPS.

One is fixed inside each side of the platform near the rear in such a position as to control the recoil, and prevent injury, either to the bottom of the hydraulic buffer, or to the piston; and consists of a powerful bracket, one ring of india-rubber, and a spindle secured in the bracket by means of a split key.

SNATCH BLOCK FOR LOADING TACKLE.

A snatch block to lead the fall of the loading tackle, with a joint shackle to connect it to a bracket fixed at the front of each girder of the platform. The joint shackle is secured to the bracket by a nut and pin, and allows of the snatch block swivelling to suit any direction of the fall.

RACERS.

The racers for 12.5-inch guns are of steel, and with the exception of A pivot rear racers are bevelled at their upper faces to suit the trucks, which are coned true to their respective distances

R.M.L. Ordnance (12·5-inch).

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from the pivots. In section the racers are solid without flanges, and of increased width to give greater bearing for the trucks; they also taper towards the top, so as to allow the trucks to revolve freely without grinding against the racers.*

Stops are fixed in the stone at the side of the racer.

The radii of the racers are as follows:—

	Front.			Rear.		
	feet.	inches.	feet.	inches.	feet.	inches.*
Pivot A	10	2			20	2
" C (centre)			5	8		
" D	8	0			3	8
						cassmate.
						dwarf.

GRADUATED ARC AND POINTER.

To indicate the angle of traverse a wrought iron pointer is attached beneath the rear of platform, which points to a graduated arc let into the floor of the work.

The method of graduation is still under consideration.

PRESERVATION OF GEAR.

The parts liable to damage by exposure, viz. :—

The elevating gear.

The front rollers with their axles.

Should be removed from all carriages except one or more (at the discretion of the Commanding Officer), which may be held in readiness for action.

The axles of the platform trucks should be occasionally oiled.

NOTES ON VARIOUS OPERATIONS IN THE SERVICE OF THE GUN.

RUNNING UP.

Raise the carriage on its rollers by means of the hydraulic jack, rear roller; and release the compressor stop by lifting the weighted lever. When the carriage has been run up clear of the compressor stop, the weighted lever must be pressed down towards the front of the platform.

Should it be found that the gun is running up too quickly, lower the carriage off its rollers by forcing the pumping handle to the rear, thereby releasing the pressure in the rear roller jack (see description of this jack at page 279).

* NOTE.—The radius of rear racers for cassmate platforms to give 7 feet recoil is 21 feet 2 inches.

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ELEVATING.

To elevate, release the clamping arrangement by lifting the handle of the screw towards the front, and turn the hand wheel to the right (or towards the front); when the required elevation is obtained, clamp the arc by pressing the handle down towards the rear.

DEPRESSING.

To depress, release the clamping arrangement, as for elevating and reverse the movement of the hand wheel; and again clamp the arc.

Should the position of the handle of the clamping arrangement be found to be inconvenient when the arc is clamped, it can be adjusted by removing the split key and handle, and replacing the latter in the new position on the hexagon of the screw, then refixing the split key.

TRAVERSING.

Force the friction cone into the recess of the bevel pinion on cross shaft, by means of the hand wheel on left side of platform, turning the hand wheel to the left (or towards the front), when the indicator behind the hand wheel will be lowered to T.

For "*Trail right*," turn the winch handles towards the rear.

For "*Trail left*," reverse of the above.

RUNNING-BACK CARRIAGE.

Disengage the lever on left side from the catch, and lift it towards the front, until the teeth of the sprocket plates catch in the running-in-and-out chains on the platform. Raise the carriage on its rollers, as for "*Run up*," and continue to hold up the lever until the carriage is run back. Lower the carriage off its rollers, and disengage the sprocket plates by forcing the lever down until it is again held by the catch.

PLATFORM.

While the carriage is on its rollers and the sprocket plates in gear with the running-in-and-out chains, raise the weighted lever of the compressor stop, and hold it up; force the friction cone into the recess in the spur pinion by means of the hand wheel on the left side, turning the latter to the right (or towards the rear), the indicator will then rise to R; then turn the winch handles towards the front until the carriage has been run back the required distance.

R.M.L. Ordnance (12·5-inch).**Section I.****ENGAGEMENT OF CHAINS IN SPROCKET.**

Should the running-in-and-out chains not be in a position suitable for the engagement of the sprocket plates in the carriage, move the chain slowly, at the same time pressing the lever on the carriage steadily up, until the teeth catch in the chains.

**DRILL WITH R.M.L. ORDNANCE 12·5-INCH GUN ON
A CASEMATE TRAVERSING PLATFORM.**

The Detachment consists of 17 Nos., and falls in two deep.

TO TELL OFF.

<i>Officer.</i>	<i>No. 1.</i>
<u> </u>	<u> </u>
<i>Tell off.</i>	

At "*Tell off*" No. 1 (who is on the left of the front rank) takes a pace to his front, turns to his right, and numbers himself 1; the right hand man of the rear rank numbers 2; the right hand man of the front rank 3, and so on. After the detachment is told off, No. 1 falls in again on the left of the front rank.

The detachment is marched into the casemate and halted in line, facing the shield, and to the left rear of the platform. The detachment is now in the position of "*detachment rear*."

TO TAKE POST UNDER COVER.

<i>Officer.</i>	<i>No. 1.</i>
<u> </u>	<u> </u>
<i>Take post under cover.</i>	<i>Right turn.</i>
	<i>Double march.</i>

The detachment, stepping off, wheels to its left at the left corner of the platform, the front rank filing to the left of the gun, the rear rank to the right; 2 and 3 halting close to the shield, and near the port; 4 and 5 forming upon their right and left; 12 on the right of 4, the whole turning to the right-about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 11 go to the head of the cartridge lift; 7 and 9 to the head of the shell lift; 8 and 14 to the cartridge store; 17 to the foot of the cartridge lift; 10 and 13 to the shell store; 15 to the foot of the shell lift; 16 goes under cover outside 12.

GENERAL DUTIES.

No. 1 commands, directs, or superintends the boring and fixing fuzes, assists (if required) to raise projectile, attends to valve lever of running-up jack, and lays, attends to indicator.

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No. 2 searches, sponges, assists 3 with cartridge, steadies and guides projectile in raising, rams home, assists 12 to attend to mantlet, and elevates.

No. 3 searches, sponges, loads, hooks and unhooks hoisting tackle, steadies and guides projectiles in raising, uncaps fuze when in bore, attends to port bar, rams home, pumps the running-up jack, and assists 11 to attend to mantlet.

No. 4 attends to side arms and supplies them to 2, rams home, and traverses.

No. 5 supplies wedge wads, raises projectile, rams home, attends to snatch block, traverses, and attends to lever of chain nipping gear.

No. 6 supplies cartridge to 3, raises projectile, and rams home.

No. 7 attends to fuzes, brings up projectile, raises it, and rams home.

No. 8 attends to cartridge store and serves out cartridges.

No. 9 assists 7, raises projectile, and removes empty barrow.

No. 10 attends to shell store.

No. 11 supplies 3 with cartridge, raises projectile, rams home, attends to mantlet, and traverses.

No. 12 rams home, attends to mantlet, and traverses. Attends to compressor stop.

Nos. 13 and 15 supply shells to the lift from the shell store.

Nos. 14 and 17 supply cartridges to the lift from the cartridge store.

No. 16 assists 4 with side arms, rams home, attends to vent, makes ready and fires.

TO PREPARE FOR ACTION.

Officer.

Prepare for action.

No. 1.

*Prepare for action.
Examine gun.*

"*Prepare for action.*"—No. 1 provides and fixes sights. []

No. 2, elevating wheel, and assists 4 with side arms.

No. 3, hoisting tackle, consisting of double and treble blocks, and handle of running-up jack. He removes the muzzle tampeon.

No. 4, sidearms.

No. 5, wedge wads and two traversing handles.

No. 6, cartridge cylinder and dummy cartridge for drill purposes, bucket filled, and brush, and two wood cartridge bearers, for use if required.

No. 7, fuzes, fuze and shell implements, and leather strap for slinging projectile. He obtains the fuze boxes from 10, satisfying himself as to correctness of fuzes and fuze implements.

No. 8 goes to the cartridge store and prepares to issue [cartridges].

R.M.L. Ordnance (12·5-inch).Section I.

No. 9, transporting barrow and a brush.

No. 10 goes to the shell store and prepares to issue shells, tubes, and fuzes. He examines the shells carefully, cleaning them if necessary, and removing burrs from studs; he loosens the fuze hole plugs of shells that will be first issued.

No. 11 cartridge cylinder and dummy cartridge for drill purposes, brings up rammer ropes when fitted with spring clips.

No. 12 assists 4 with side arms.

Nos. 13 and 15 go to the shell store.

Nos. 14 and 17 to the cartridge store.

No. 16 provides tubes in box, lanyard, pricker, and vent server.

Nos. 8 and 10 satisfy themselves that the lamps in the ammunition stores are burning brightly.

Nos. 13 and 14 that the hoisting gear at the shell and cartridge lifts work easily.

Any irregularity in these respects should be at once reported to No. 1.

The stores having been brought up, or found correct, No. 1 will satisfy himself that the foresights fit properly on the gun, and the deflection leaves of the hind sights work easily. He ascertains that the hydraulic buffer is filled with the proper amount of oil, and that the racers are swept; that the running up jack, indicator, and clutch lever are in working order; he receives reports from the Nos. responsible of any irregularity or deficiency in connection with the different parts of the gun carriage, platform and stores, or as regards the ammunition stores, lifts, &c.

2 and 4 place the sponge and rammer in the supports suspended from the roof, the shell extractor and wad hook in rear, so as not to interfere with the working of any of the guns in the battery, and convenient for those for which intended.

2 sees that the elevating gear, 4 that the traversing gear is oiled and in good working order.

3 examines the bore to see the grooves are free from grit, &c., secures the hoisting tackle to the loading bar, overhauling it until the lower block is at a convenient height for hooking to the strap on the projectile. The lower block should then be hooked back to a loop on the left mantlet.

5 ascertains that the lever of chain nipping gear is in working order.

6 places the sponge bucket clear of the working of the gun.

11 coils down the rammer ropes either side of the gun, and, with 12, sees that the mantlets work easily.

12 sees that the compressor is in adjustment.

16 places the pricker in the loop on the side of the carriage, examines the vent server and places it in the vent (the loop of the vent server lanyard over one of the sights), straps the tube box round his waist on the right side, coils up the lanyard, and passes the bight of it under the tube box strap; fills his box with friction tubes, which he procures from 10.

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No. 1 gives the word "*Examine gun*;" 16 drifts the vent, replaces the vent server and clamps the elevating gear; 2 and 3 search the gun after the pricker is withdrawn, 2 supplying himself with the wad hook, and replacing it; 12 elevates until the gun is in a convenient position for loading, and clamps the elevating gear.

TO LOAD.

<i>Officer.</i>	<i>No. 1.</i>
<i>Range, — yards.</i>	<i>Trail right or left (if necessary),</i>
<i>With — load</i>	<i>Halt</i>
	<i>With — load.</i>

"*Trail right or left.*"—No. 1 adjusts the indicator for traversing; 4, 5, 11, and 12 trail right or left.

The gun is traversed to a convenient position for loading if necessary.

"*Load.*"—No. 1 gives 7 the nature of shell (and length of fuze required) and adjusts the tangent sight.

2 moves into position for sponging, receives the sponge from 4, and, assisted by 3, sponges the gun, being careful to observe that the vent server is in the vent. He returns the sponge to 4 and, with 3, steadies the projectile in raising and guiding it into the bore. He then receives the rammer from 4 (with right rammer rope attached), and assisted by 3, steadies the stave, whilst the cartridge and projectile are being rammed home. The rammer ropes being manned by 4, 6, 12, and 16 on the right, 5, 7, 9, and 11 on the left of the gun. Should "*Not home*" be given by 2, they again stand to the ropes and force the charge home. At "*Home*" they go under cover; 2 and 3 detach the rammer ropes (if fitted with spring clips), hand them to 11 and 12, spring the rammer; 3 inserts a wedge wad, which is pressed steadily home by 2 and 3, and jammed under the head of the projectile by two smart taps. They then spring the rammer (2 handing it to 4), and go under cover.

3 moves into position, and having fixed the port bar and assisted 2 to sponge, slews to his right, withdraws the first cartridge from the cylinder, placing it on his right shoulder, choke to his front, he then turns left about until his back is towards the muzzle and slides the cartridge from off his shoulder into the bore. He does the same with the second cartridge. The projectile is now brought up on the barrow with strap ready fixed; 3 standing clear, close to the front of the platform, 5 casts loose the lower block of the hoisting tackle, and 3 hooks it into the strap, and gives "*Hoist away,*" and with 2 steadies and guides the projectile, which is raised by 5, 6, 7, 9, 11, and 1 if necessary, manning the

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running end of the fall; 3 gives "*High enough*," "*Ease off*," and, having, with 2, forced the projectile into the bore, casts loose the strap, replacing it in the barrow, and uncaps the fuze. The barrow may be pushed clear by 3 before hoisting. 3 now hooks the left rammer rope, which he receives from 11, and the charge and wedge wad are rammed home in succession, the rammer sprung by 2 and 3, and the port bar unshipped by 3.

4, assisted by 16, hands the sponge to 2 and receives it back from him; he hands him the rammer as soon as the projectile is in the bore, and mans the rammer rope. When the projectile and wedge wad have been sent home, he receives the rammer back from 2, and assists 16 to replace it.

5, as soon as the cartridge is in the bore, casts loose the lower block of the hoisting tackle, attends to snatch block, mans the fall in raising the projectile, and the rammer rope in ramming home. When the charge is home he supplies 3 with a wedge wad, and hooks the lower block of the hoisting tackle to the loop on the left mantlet.

6, after supplying 3 with cartridge, which he brings up on his shoulder, lid to the rear, mans the fall of hoisting tackle and afterwards the rammer rope on the right of the gun.

7 brings up projectile in barrow with straps on, having, when necessary, adjusted the fuze according to No. 1's directions, assists to raise and ram it home.

8 issues a cartridge to 6.

9 assists 7 to prepare, bring up, and raise and ram home projectile, removes barrow and strap.

10 issues shell.

11 after supplying 3 with cartridge, raises and rams home projectile, and attends to the left mantlet and left rammer rope.

12 rams home, attends to the right mantlet and right rammer rope.

13 and 15 work the shell lift.

14 and 17 the cartridge lift.

16 lowers the sponge and rammer in succession from the rope support in the roof of the casemate, and assists 4 to hand them to 2, replacing them with 4's assistance.

N.B.—When rammer ropes, fitted with "spring clips," are not in use, they are coiled down between the racers close to the piers by 11 and 12.

To RUN UP.

Officer.

No. 1.

Run up. Halt.

"Run up." 12 releases the compressor by raising the weighted lever, holding it up until the carriage has moved clear; when clear, he presses down the lever towards the front of the plat-

Section I.

R.M.L. Ordnance (12.5-inch).

form. No. 1 stands to the running-up jack (screwing up the valve lever should the release valve be external). No. 3 pumps up the jack until the gun begins to move to the front. No. 1 checks it if necessary by forcing the lever to the rear, or (should the release valve be external) by unscrewing the valve lever handle.

When up to the front stops No. 1 gives "*Halt*," and lowers the rear of the carriage as described for checking it. (Should the running-up jack be out of order, the gun can be run up by use of the chain nipping gear, in which case No. 1 adjusts the indicator for running up; 5 raises the lever of the chain nipping gear towards the front, 4, 5, 11 and 12 work the traversing handles.) After the gun is run up 5 hauls down the lever of chain nipping gear, 16 hooks a tube to the lanyard; 2, 3, 11, and 12 close the mantlets.

TO LAY THE GUN (see SECTION IV., PAGE 336).

*Officer.**No. 1.**Elevate. Halt.**Depress. Halt.**Trail right. Halt.**Trail left. Halt.*

No. 1 adjusts the indicator for traversing, and then, looking over his sights, gives "*Elevate*," &c., as required. 2 at "*Elevate*" releases the clamping arrangement of elevating gear by lifting the handle of the clamp towards the front; he then turns the hand wheel to the right (or towards the front). At "*Depress*" he reverses the movement of the hand wheel; at "*Under cover*" or "*Ready*" he clamps the elevating arc by pressing the handle down towards the rear. 4, 5, 11, and 12 work the traversing handles, turning them towards the rear for "*Trail right*," the reverse for "*Trail left*."

TO MAKE READY AND FIRE.

*Officer.**No. 1.**Fire — rounds.**No. — Ready.**No. — Fire.*

At "*Ready*" the gun Nos. stand clear. 16 places the tube in the vent, passes the lanyard through the rear eyebolt of the carriage, and stands ready to fire, facing the gun. At "*Fire*" he draws the lanyard strongly towards him without a jerk; he drifts the vent, replaces the vent-server, and coils up the lanyard, placing it under his belt. As soon as the gun has been fired 11 and 12 (assisted by 4 and 5 if necessary) will traverse it back to a position convenient for loading, without any word of command.

R.M.L. Ordnance (12·5-inch).**Section I.****TO RUN BACK AND UNLOAD.**Officer.No. 1.

Run back. Halt.
Unload.

At "*Run back*" No. 1 adjusts the indicator for running back; 5 raises the lever of chain nipping gear until the teeth of the sprocket plates catch in the running-in-and-out chains on the platform, and holds it up (or secures it) until the gun having been run back the carriage is lowered on to the platform, after which he forces the lever down until it is held by the catch; 3 works the lever of running up jack until the rear of the carriage is raised.

4, 12, 16 on the right, 5, 9, 11 on the left work the traversing handles, 12 raises the compressor lever. As soon as the gun is back No. 1 gives "*Halt*," and forces the lever of jack as far to the rear as possible, or (if the release valve is external) unscrews the release valve, until the rear of the carriage rests on the platform.

No. 1 then adjusts the indicator for traversing.

"*Unload*." The gun is unloaded by the same Nos. who loaded it.

TO CEASE FIRING AND REPLACE STORES.Officer.No. 1.

Cease firing.
Replace stores.

Depress. Halt.
Replace stores.

The gun is depressed and the stores are replaced by the Nos. who brought them up.

TO FORM DETACHMENT REAR.Officer.No. 1.*Detachment rear.*

Outwards turn. Double march.
Halt. Front.

"*Detachment rear*," No. 1 doubles to the left rear of the platform, faces to his left, and gives the order "*Outwards turn*;" 2, 4, 12, and 16, turn to their left, 3 and 5 to their right.

"*Double march*," 16 and 5 followed by 12, 4, 3 and 2, wheel to their right and left, and when clear of the platform, to the right and round No. 1's left shoulder, 6, 7 and the remaining numbers coming up into their places; when 2 and 3 have passed him No. 1 gives "*Halt*," "*Front*," and changes his flank by the rear.

Section I.

R.M.L. Ordnance (12.5-inch).

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<u>Change rounds.</u>	<u>Change rounds.</u>

In changing rounds, 2 becomes 4, 4 1, 1 17, 17 16, 16 15, 15 14, 14 13, 13 12, 12 11, 11 10, 10 9, 9 8, 8 7, 7 6, 6 5, 5 3, and 3 2.

SERVICE OF 12.5-INCH R.M.L. GUN IN BARBETTE BATTERY WITH SUNKEN WAYS.

The guns are fitted with muzzle derricks and supplied with loading stages.

The running end of the fall of the hoisting tackle is led through an ordinary single 8-inch Bothway block, which is hooked into a permanent eye let into the wall of the parapet.

Two 4-inch snatch blocks are hooked to the loops or eyes on the derrick and the bell ropes of the rammers are passed through them. The snatch blocks are hooked for "*Loading*" by 2 and 3, unhooked by them when the wedge wad has been rammed home, and laid down with the rammer ropes when not in use by 11 and 12, who attend to them. The upper block of the hoisting tackle should be moused with spun yarn.

The service of the guns is the same as for those mounted in casemates and behind shields with the following exceptions:—

"*General duties*," 5 attends to muzzle derrick; 7 and 9 attend to loading stage.

"*Prepare for action*," 5 an 8-inch single Bothway block; 11 two 4-inch snatch blocks, which he hooks on to the derrick; 9 tackle for hoisting projectiles on to loading stage.

2 and 4 place the sponge and rammer on the ground on the right of the gun.

"*To load*," 5, as soon as the cartridge is in the bore, raises the derrick and overhauls the tackle; after supplying 3 with a wad he rounds in the tackle and throws back the derrick, 7 and 9, assisted by 13 and 15, having placed a projectile on the loading stage, run it under the muzzle of the gun, and after the rammer has been withdrawn from the bore, run the stage back to its former position.

If no crane or derrick is available for lifting projectiles on to the loading stage, they can be rolled on on a plank.

The paragraphs relating to portbar, mantlets, and transporting barrow do not apply to this drill, the barrow being required for conveying projectile to loading stage only.

N.B.—For guns mounted en barbette without sunken ways, a transporting barrow is used for conveyance of projectile to the muzzle of the gun, instead of a loading stage.

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SERVICE OF GUNS MOUNTED ON TURNTABLES.

When 38-ton guns are mounted on turntables to shift from one port to another may be done by the same numbers as with the 10-inch, 11-inch, and 12-inch R.M.L. Gun. *Vide* p. 274.

DRILL BY SIGNALS.

Detachments, well drilled, can be exercised in the service of guns by means of signal; (to be used instead of words of command for which they stand), unless smoke, darkness, or some other absolute necessity renders the word of command necessary.

This method possesses the advantage of enforcing silence, and compels the numbers working at the gun to fix their attention on the No. 1 or other number giving the signal.

DRILL BY SIGNALS FOR CASEMATE BATTERIES.

<u>Officer.</u>	<u>No. 1.</u>
<i>Prepare for action.</i>	• <i>Prepare for action.</i>
<i>Range—yards.</i>	<i>Examine gun.</i>
<i>With—load.</i>	<i>With—load.</i>

No 1. mounts upon the platform and adjusts his tangent scale; the other numbers act as usual.

(No. 3. "*Hoist away*") No. 3 raises his right hand palm to the rear, fingers pointing upwards.

(No. 3. "*High enough*") No. 3 again raises his right hand as before.

(No. 3. "*Ease off*") No 3 repeats the signal with his right hand as before.

(No. 1. "*Run up*") No. 1 standing in rear of the platform holds up his right hand, palm to the front; 2 and 3, 4 and 5 then proceed as usual.

(No. 1. "*Elevate*") No. 1 looking over the sights holds up his right or left hand fingers pointing upwards (according as the right or left elevating wheel is in gear).

(No. 1. "*Depress*") No. 1 turns his hand, so that the fingers point downwards.

(No. 1. "*Halt*") Drops the hand to the side.

(No. 1. "*Trail right or left*") Motions with the right hand in the required direction, the arm well back, resting on the body.

(No. 1. "*Halt*") Drops the arm.

(No. 1. "*Under cover*") No. 1 jumps off the platform, and goes under cover with the other numbers.

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As soon as the gun is fired, the vent is drifted, the vent server is replaced, and the loading and firing is proceeded with until the specified number of rounds have been fired. The whole of the numbers then go under cover.

The service of the gun is to be carried out without any word of command after the order of the Officer to "*Load*," and with the least possible noise.

When the object is stationary and the front obscured by smoke, the gun may be laid by means of the index plate and reader, combined with the arc on the floor and pointer on platform; the positions of which should be carefully noted when the gun is laid by the tangent sights.

The above drill can only be effectively carried out by careful training of the detachments, who should be instructed to fix their attention on the Nos. issuing the orders.

In all respects not above mentioned the drill is the same as laid down for the different natures of ordnance.

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Section II.

Rifled Breech-Loading Ordnance.

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GENERAL OBSERVATIONS.

The present system of rifled B.L. ordnance, introduced in 1859, is commonly known as the Armstrong B.L. system.

It may be considered briefly under three heads:—

1. General construction of the gun.
2. System of rifling.
3. Method of closing the breech.

The construction of these guns consists of an inner barrel, sometimes of a solid forging bored out, but more usually of a number of coiled wrought iron bars, joined lengthways, and welded together, a forged breech piece, a forged trunnion piece, and one or more coils, according to the nature of the gun. By employing this method, great strength is given to resist transverse strain, as the fibre of the iron runs round the gun, while the breech end is strengthened by the forged breech piece, in which the fibre runs longitudinally, or in the best position to prevent the breech from being blown out; the addition of one or more coils, which are afterwards shrunk on, tends to compress the whole together, and to ensure a fair share of the strain being borne by every part of the gun.

The system of rifling is the polygroove, the number of grooves varying with the calibre of the gun, rotation being given to the projectile by enveloping it in a soft metal coating of such thickness that the diameter of the projectile is slightly larger than that of the bore, the lands being made narrow compared with the grooves, in order to cut more readily into the soft coating.

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The closing of the breech is effected by the use of a wrought-iron stopper or block provided with a coned face, fitting accurately into the breech end of the gun, and introduced through an opening or vent slot. This is kept in its place by means of a breech screw, the face of which acts upon its back, and which is screwed up by means of a lever and tappet ring in rear.

40-PR. R.B.L. GUNS.

DESCRIPTION.

	32-cwt. gun.	35-cwt. gun.
Calibre (<i>i.e.</i> diameter of grip)	4.75 in.	4.75 in.
Nominal Weight	32 cwt.	35 cwt.
Preponderance	5 cwt. 1 qr. 19 lbs.	4 cwt. 3 qrs.
Length {	of barrel ..	8 ft. 10.375 in.
	of powder chamber	13.5 in.
	of shot chamber	7 in.
	total, nominal ..	10 ft. 1 in.
Rifling {	grooves, number	56
	uniform ..	1 turn in 36.5 calibres.

PATTERNS.

The 32-cwt. gun was introduced in 1859 for the navy as a broadside or pivot gun; it is also now used in the land service for batteries of position, siege and garrison purposes.

The 35-cwt. gun was introduced in 1860. It has a longer and stronger breech-piece and a raised coil in front of the vent slot.

The fittings of the two guns are interchangeable, except the breech screws, which have a different shape and pitch of thread.

CONSTRUCTION.

The gun (of either pattern) consists of an A tube; breech piece; B tube; trunnion ring; and three coils.

PARTS.

The *vent piece* is a block of wrought iron or steel for the purpose of closing the breech. The vent passes vertically through it as far as the centre, and is then bored horizontally in a position coinciding with the axis of the bore.

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The *breech screw* fits the thread cut in the breech piece, its object being to send home and retain the vent piece in its proper position.

The *tappet ring* is fitted on the octagonal part of the breech-screw on which it acts as a wrench, the power being communicated through its projections from the tappets on the lever.

The *lever* fits on the breech screw behind the tappet ring; it is free to revolve round the breech screw, but is prevented from falling off by two keep pins working in grooves. The object of the lever and tappet arrangement is to gain a powerful momentum in tightening up and relaxing the vent piece from its seat in the gun.

The *indicator ring* is a thin narrow ring of wrought iron fitted on the breech screw in front of the tappet ring; it must be so adjusted on the screw that when the vent piece is home, the raised line of brass or arrow on the ring will coincide with or be slightly to the left of the mark on the breech.

The *breech bush* is a ring of copper screwed into the end of the powder chamber by means of the facing implements.

The *vent piece copper ring* is a corresponding ring on the face of the vent piece. The object of these rings is to prevent the escape of gas; they are coned in opposite directions so as to fit closely into one another.

During continuous practice with 40-pr. R.B.L. guns, the vent pieces should be changed at the end of every fifteen rounds; the vent-piece not in use is thus allowed time to become thoroughly cool, and opportunity should then be taken to examine it carefully with reference to the state of the copper ring, &c.

RIFLING.

The rifling is the Armstrong polygroove.

Depth of groove	..	..	0 to .06 inch.
Width of groove	..	..	.166 inch.
Width of lands	..	..	.1 inch.

VENTING.

The vent passes vertically down the centre of the vent piece, and is continued at right angles in prolongation of the axis of the bore; the vertical portion is partially bushed with copper.

SIGHTING.

The gun is provided with four sights, viz.; 2 tangent scales, and 2 trunnion sights, one of each on each side; the former being graduated (in the latest pattern) to 15°, and furnished with sliding-
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leaf heads. The tangent sights are set in the gun at an angle of $2^{\circ} 16'$ to compensate for the drift; they are provided under the cross-head with an "elevating nut," by turning which any number of minutes of elevation less than $10'$ may be given.

Many tangent sights of the older pattern still exist having "barrel heads" for giving deflection.

The bars of the tangent sights are four-sided and (in the latest pattern) are marked as follows:—



The trunnion sights are of the "drop" pattern, and secured by a bayonet joint.

Tangent sights are interchangeable for all guns of the same nature.

PROJECTILES.

	Weight.
	lbs. ozs.
Shot, case, filled, with 35 8-ounce sand shot, clay and sand	31 8
„ solid (for practice only)	41 3
„ drill, a recovered shell with the lead coating slightly turned down.	38 0
Shell, segment, empty	39 0
„ „ filled about	39 13
„ shrapnel, filled with 162 mixed metal bullets, 16 to the pound; bursting charge, 3 ounces	39 3
„ common, empty about	38 5
„ capacity for bursting charge	2 4

Case shot is used for close quarters against troops or boats; common shell against earthworks, buildings, &c.; segment and shrapnel against troops beyond the range of case shot.

CHARGES.

Service, 5 lbs. L.G. or R.L.G. powder.

Saluting or exercise, 3 lbs. exercise powder.

The service cartridge has a lubricator choked into it to lubricate and clean the bore, and to prevent the leading of the grooves.

VELOCITY.

Muzzle velocity, 1180 feet.

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FUZES.

Wood, time { 20-seconds, B.L.O. for common and segment.
 9 " " for all shell.
 5
 Percussion, R.L. Mark II., for all shell, acting on graze or impact.
 Primers for vent pieces are used with these guns.

TIN CUPS

Are used at practice only, to assist in closing the breech, and as a protection to the copper rings. They are issued in the proportion of 1 to 10 rounds.

CARRIAGES.

The following are the carriages in use:—

			Weight.
Garrison, wood, standing	..	..	13 $\frac{3}{4}$ cwt.
" iron, "	..	..	17 $\frac{1}{4}$ "
Siege, wood, with sidearms	..	..	30 $\frac{1}{4}$ "

DRILL WITH 40-PR. R.B.L. GUN ON TRAVELLING SIEGE CARRIAGE.

The Detachment consists of nine numbers, and falls in two deep.

TO TELL OFF.

<i>Officer.</i>		<i>No. 1.</i>
<i>Tell off.</i>	|	—

At "Tell off" No. 1, who is on the left of the detachment takes a pace to his front, turns to his right and numbers himself 1; the right hand man of the rear rank numbers himself 2; the right hand man of the front rank 3, and so on to the left.

After the detachment is told off, No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery, and halted in line, facing the parapet, and to the left rear of the platform.

The detachment is now in the position of "detachment rear."

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TO TAKE POST UNDER COVER.

<u>Officer.</u>	<u>No. 1.</u>
<i>Take post under cover.</i>	<i>Right turn.</i> <i>Double march.</i>

The detachment, stepping off, wheels to its left at the left corner of the platform; the front rank filing to the left of the gun, the rear rank to the right; 2 and 3 halting close to the parapet, and near the embrasure; 4 and 5 forming upon their right and left, and the whole turning to the right-about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 go to the cartridge store (6 outside) and 7 and 9 to the shell store (7 outside).

TO TAKE POST AT THE GUN.

<u>Officer.</u>	<u>No. 1.</u>
<i>Take post at the gun.</i>	<i>Right turn.</i> <i>Double march.</i>

Where there is no parapet, the detachment files on the gun at "Take post on the gun," Nos. 2 and 3 halting in line with the breech, 4 and 5 the centre of the trail, the whole in echelon outwards. No. 1 in rear of the gun, and 6, 7, 8, and 9 with the limber.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, directs the gun into the line of fire when running up, and lays.

No. 2 runs up, sponges (if necessary), rams home, and traverses.

No. 3 runs up, removes safety pin or uncaps fuze, loads, rams home, and traverses.

No. 4 runs up, attends to breech screw, vent piece, and tin cups when used, attends to sidearms and supplies them to 2, and to elevating screw in laying.

No. 5 runs up, attends to breech screw and vent piece, primes, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes and brings up projectile.

No. 8 attends to cartridge store or limber, and serves out cartridges to 6.

No. 9 attends to shell store or limber, and issues shells, tubes, and fuzes.

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TO PREPARE FOR ACTION.

<i>Officer.</i>	<i>No. 1.</i>
<i>Prepare for action.</i>	<i>Prepare for action.</i> <i>Examine gun.</i>

"Prepare for action."

The stores are brought up as follows :—

No. 1, 6 ft. handspike sights, and file for vent piece.

No. 2, 6 ft. handspike, and assists 4 with sidearms..

No. 3, 6 ft. handspike and elevating screw ; he also removes apron and tampeons.

No. 4, 6 ft. handspike, sidearms, and support, tin cups in pocket and tin cup extractor.

No. 5, 6 ft. handspike, primers in pocket, tubes in box, lanyard, oil can, and hemp.

No. 6, two cartridge cases, which he leaves at the cartridge store or limber, bucket, filled, and brush, two drill cartridges for drill purposes.

No. 7, fuzes, fuze and shell implements. He obtains the fuze boxes from 9, having ascertained from No. 1 the nature of fuzes required, satisfying himself as to the correctness of fuzes and fuze implements.

No. 8 prepares to issue cartridges.

No. 9 provides a brush for cleaning shell, prepares to issue shells, tubes, and fuzes. He examines the shells carefully, cleaning them if necessary, and removing burrs. He loosens the fuze-hole plug of shells that will be first issued.

The stores having been brought up, No. 1 will satisfy himself that the foresights fit properly on the gun, that the deflection leaves of the tangent sights work easily, and that the platform is properly swept. He receives reports from the numbers responsible of any irregularity or deficiency in connection with the gun, ammunition, or stores. He ascertains that the breech fittings are properly put on and well oiled.

Should the indicator ring require adjusting, he adjusts it in the following manner:—The vent-piece is screwed home as for firing ; the lever and tappet ring are then removed ; the indicator ring is passed over the octagonal part of the breech screw, so that the arrow marked on it, or raised line, will correspond with a similar mark on the gun. If the arrows cannot be made to coincide, the indicator ring is to be so placed that the arrow on it will be to the left of the mark on the gun, as close as the cogs on it will permit. The tappet ring and lever are then replaced.

These should be put on so that the lever ball will be resting on a cam of the tappet ring on the right side of the gun, in a convenient position for 4 to give two taps after the breech is screwed up.

The side arms are laid down to the right of the gun and

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parallel to it, heads to the front, resting on the support provided, sponge next the gun, and in line with the breech when the gun is run up. The sponge bucket is placed near the sponge head.

The handspikes are laid down bevels up, two on each side of the platform, close to the carriage, points to the front; those of 2 and 3 outside and about 2 feet in advance of those of 4 and 5. No. 1 places his handspike parallel to the others, but in rear of the platform. The tin cup extractor is placed in a loop on the carriage. If the indicator, tappet ring, with keep-pins and lever, have been detached, 4 and 5 bring them up and put them on, under the superintendence of No. 1. No. 4 sees that the elevating screw is properly oiled; 5 straps the tube box round his waist on the right side, and the primer pocket on his left side, doubling the lanyard in four and placing it under his belt. He fills the tube box with friction tubes, which he procures from No. 9.

If the gun is to be prepared for drill only, 8 and 9 provide two selvagees and a tackle, whip upon whip. They hook the moveable block to a selvagee passed through the trail eye, and the standing end to one passed round a holdfast in rear of the platform. No. 6 provides two dummy cartridges, 7 a drill shell, and 4 a drill vent piece.

At "*Examine gun*," 4 moves the elevating screw handle until the axis of the bore is horizontal; he then opens the breech by taking the lever handle in his right hand, back up, and swinging it round a half circle towards him from cam to cam; this will strike a blow hard enough to move the screw, which is then unscrewed two turns, and the vent-piece is released. 5 then steps in, and, with 4, lifts the vent piece out of the slot and lays it on the flat surface on the top of the breech coil.

At "*Clear*," from No. 1, 4 and 5 drop in the vent piece. 5 then takes the lever handle in his left hand, back up, and turning the handle towards him, screws up the breech screw until it is home. 4 and 5 then go under cover.

If No. 1 gives "*Sponge out*," No. 2 provides himself with the sponge and sponges out the gun. At "*Clear*," 4 and 5 act as before detailed, 2 passes the sponge over his head as he turns left about, replaces it, and goes under cover.

No. 1 then directs 5 to fire a tube.

TO LOAD.

<i>Officer.</i>	<i>No 1.</i>
<i>Range</i> —yards.	<i>Run up. Halt.</i>
<i>With</i> —load.	<i>With</i> —load.

The gun is generally run up before loading. At "*Run up*," 2, 3, 4, and 5, take up their handspikes at the centre, with the hands next the parapet, backs up, the other hands at the small

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ends, backs down; 2 and 3 apply their handspikes horizontally over the spokes of the wheels in front, under the brackets close to the breast, and bear down; 4 and 5 use their handspikes as levers of the second order, under the rear part of the wheels; all the numbers facing to the rear; No. 1 applies his handspike under the trail eye, and guides the gun into the line of fire. As soon as the wheels nearly touch the hurter, No. 1 gives "*Halt*," slides his right hand, back up, to the centre of the handspike, and throws it to the rear. 2, 3, 4, and 5 withdraw their handspikes, turn inwards, lay them down, and go under cover.

At "*Load*," No. 1 gives No. 7 the nature of shell and fuze required, and during the loading fixes his tangent scale at the required elevation and deflection.

4 and 5 step in, unscrew the breech screw and lift out the vent piece; 4 removes the old tin cup with the extractor, and 5 cleans the vent piece, if required, and drops in a primer, worsted end down; 4 and 5 then go under cover.

2 and 3 then step in and place themselves in position for loading; 3 receives a shell from 7, uncaps or removes the safety pin of the fuze, and introduces the shell its own length into the bore, point to the front; 2 then receives the rammer from 4, and, assisted by 3, rams home the projectile, their outward hands back under, inner hands back up; 3 then turns to his right, withdraws the cartridge from the cartridge case, places it in the bore, choke to the front, and goes under cover; 2 presses the cartridge gently home, withdraws the rammer, replaces it, and goes under cover.

Should "*Sponge out*" be given, 2 receives the sponge from 4, introduces it into the bore, and sponges out in two motions; he then withdraws the sponge, cleaning the chamber well and hands it back to 4.

No. 4 lifts the sponge (if required) with his left hand back under, turning to the right about as he does so, and hands it to 2, waits for it, replaces it, and then takes up the rammer, hands it to 2, and goes under cover.

As soon as the gun is loaded, 4 and 5 step in, 4 passes a tin cup down the slot, edge to the front, and presses it into the bore; 4 and 5 then drop in the vent piece, 5 screwing up the breech screw as before detailed, 4 (for additional security) placing his hands on the top of the lever handle and giving two smart taps; 4 and 5 then go under cover.

No. 6 brings up a cartridge in its case, and places it on the right of 3. While the projectile is being rammed home, he uncovers the case, and as soon as 3 has withdrawn the cartridge, he removes the empty case.

7 brings up a shell, having fixed the fuze according to No. 1's directions, and hands it to 3.

8 issues a cartridge to 6.

9 issues a shell to 7.

Section II.

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TO LAY THE GUN. (See SECTION IV., PAGE 336).

Officer.No. 1.

Elevate. Halt.
Depress. Halt.
Trail, right. Halt.
Trail, left. Halt.

No. 1 looks over the sights, steadying himself by leaning on the lever.

2 and 3 pick up their handspikes and go to the end of the trail facing to the rear ready to traverse, 4 works the screw until "*Halt*" is given; 5 makes ready a tube.

At "*Trail right*," 3 heaves over the trail, and at "*Trail left*," 2 heaves it over.

N.B.—When the gun is mounted on Clerk's platform, at "*Extreme right (or left)*," 2 and 3 apply their handspikes, and, with 4 and 5, heave over the side pieces, drawing out the iron bolts in rear for that purpose; when it is necessary to shift the trail plank, 2 and 3, using the side pieces as fulcrums, place the points of their handspikes under the trail handles, and raise the trail; 4 double-mans 2's handspike; 1 and 5 shift the plank.

If it is necessary to run back, 2 and 3 apply their handspikes in front of the wheels, using them as levers of the second order; 4 and 5 take a purchase with theirs over the most horizontal spokes in rear and under the brackets, the whole facing to the rear.

At drill, the gun is run back with tackle as with standing carriages.

Should no order to fire be given when the gun is laid, No. 1 gives the order "*Under cover*."

TO MAKE READY AND FIRE.

Officer.No. 1.Fire—Rounds.

No.—Ready.
No.—Fire.

No. 1 lowers his tangent scale except when firing at a moving object, and gives "*Ready*;" 5 presses a tube into the vent with his right thumb, steps clear of the recoil, shifts the lanyard to his right hand and extends it, keeping his hand level with the vent, facing the gun; 2 and 3 lay down their handspikes, and with 4 go under cover.

At "*Fire*" 5 draws the lanyard strongly towards his body without a jerk, replaces it under his belt, and goes under cover.

R.B.L. Ordnance (40-pr.).

Section II.

TO RUN BACK AND UNLOAD.

Officer.No. 1.

Run back. Halt.
Examine gun.

At "*Run back*," which No. 1 gives (*at drill*) immediately after the gun has been fired, the detachment double out, man the fall of the tackle arranged by 8 and 9 for the purpose, and haul the gun back, No. 1 scotching the right wheel and giving "*Halt*" when the gun is sufficiently run back.

At "*Examine gun*," 4 and 5 unscrew the breech screw and take out the vent piece as before detailed; 2 forces the drill projectile and cartridge through the bore with the sponge; 6 and 7 receive them at the muzzle and carry them to the rear; 4 and 5 replace the vent piece and screw up the breech screw.

TO CEASE FIRING AND REPLACE STORES.

Officer.No. 1.

Cease firing.
Replace stores.

Examine gun.
Sponge out. Clear.
Depress. Halt.
Replace stores.

At "*Cease firing. Replace stores*," No. 1 gives "*Examine gun*," which is carried out as before detailed. At "*Depress*," 4 lays the gun "*Under metal*." At "*Replace stores*" the stores are replaced by the Nos. who brought them up.

N.B.—The above drill has reference to a detachment under cover, but is applicable, with trifling modifications, to the case where there is none, and the detachment takes post at the gun.

TO FORM DETACHMENT REAR.

Officer.No. 1.*Detachment rear.*

Outward turn.
Right about turn.
Double march.
Halt. Front.

At "*Detachment rear*" No. 1 doubles to the left rear of the platform, faces to the left, and gives "*Outwards turn*;" 2 and 4 turn to their left, 3 and 5 to their right.

Section II.

R.B.L. Ordnance (40-pr.).

"Double march," 4 and 5, followed by 2 and 3, wheel to their right and left, and when clear of the platform to the right, and round No. 1's left shoulder, 6, 7, 8, and 9, coming up into their places; when 2 and 3 have passed him No. 1 gives "*Halt. Front,*" and changes his flank by the rear.

TO CHANGE ROUNDS IN ACTION.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change rounds.</i>	<i>Change rounds.</i>

In changing rounds No. 2 becomes 4; 4, 1; 1, 9; 9, 8; 8, 7; 7, 6; 6, 5; 5, 3; and 3, 2.

TO CHANGE ROUNDS WHEN LIMBERED UP.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change rounds.</i>	<i>Change rounds.</i>

In changing rounds No. 2 becomes 4; 4, 6; 6, 8; 8, 1; 1, 9; 9, 7; 7, 5; 5, 3; and 3, 2.

TO UNLIMBER.

This must be done when the gun is in the firing trunnion holes.

<u>Officer.</u>	<u>No. 1.</u>
<i>Unlimber.</i>	<i>Prepare to unlimber.</i>
	<i>Lift.</i>
	<i>Limber drive on.</i>
	<i>Lower.</i>

"Prepare to unlimber," No. 1 unkeys the keep chain, and with 2, 3, 4, 5, 6, and 7, stands to the trail, 2 and 3 nearest the gun.

If there are no horses, 9 goes to the shafts, and 8 to the splinter bar on the near side.

At "*Lift,*" the trail is lifted clear of the pintail; at "*Limber drive on,*" the limber moves on, and at "*Lower,*" the trail is lowered to the ground.

TO LIMBER UP.

<u>Officer.</u>	<u>No. 1.</u>
<i>Limber up.</i>	<i>Prepare to limber up.</i>
	<i>Lift.</i>

R.B.L. Ordnance (40-pr.).

Section II.

The several Nos. place themselves as for unlimbering, and at "*Lift*," lift the trail until the muzzle rests on the ground; they then close in towards the breech and haul down the trail when the limber is in position for limbering up; No. 1 keys up, and the detachment forms the order of march as hereinafter detailed.

POSITION OF DETACHMENT WHEN LIMBERED UP.

In Order of March.

No. 1 in line with the point of the near shaft and two yards on the left of it.

2 and 3 in line with the axle-tree of the gun carriage.

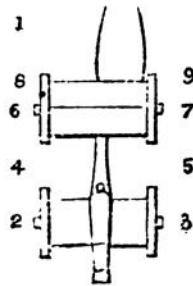
4 and 5 in line with the centre of the trail.

6 and 7 in line with the axle-tree of the limber.

8 and 9 in line with the splinter bar.

The Nos. stand covering one yard from the wheels.

Fig. 1.

*In Front.*

Two deep, two yards in front of the shafts or the leaders' heads.

In Rear.

Two deep, two yards in rear of the muzzle of the gun.

Right or Left.

Two deep, in line with the gun axle-tree, one yard to the right or left of the wheel.

CHANGE OF POSITION OF DETACHMENTS.

To form the Order of March from Detachment Front.

Officer.

No. 1.

Form the order of march.

Right turn. Double march.

Section II.

R.B.L. Ordnance (40-pr.).

"*Right turn. Double march.*" No. 1 turns with the detachment; 2 and 3 wheel to their right and open out; each number halts when at his post; they turn to the front together, looking to 2, who turns about immediately he arrives at his post.

To form the Order of March from Detachment Rear, Right, or Left.

<u>Officer.</u>	<u>No. 1.</u>
<i>Form the order of march.</i>	<i>Left turn. Double march.</i>

When the detachments are in rear or on the right they proceed direct, but when on the left they countermarch to the left; No. 1 heads the rear rank. Each No. halts when at his post.

TO CHANGE FROM FRONT TO REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Right turn. Double march.</i>
	<i>Rear turn.</i>
	<i>Right turn. Halt. Front.</i>

When the detachment is clear of the gun it turns to the rear; when in line with the position of "*Detachment rear*," it turns to the right, and when in rear of the muzzle it halts and fronts.

TO CHANGE FROM REAR TO FRONT.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment front.</i>	<i>Right turn. Double march.</i>
	<i>Front turn.</i>
	<i>Left turn. Halt. Front.</i>

When the detachment is clear of the gun it turns to its front; when in line with the position "*Detachment front*," it turns to its left, and when in front of the leading horses it halts and fronts.

TO CHANGE FROM REAR TO RIGHT OR LEFT.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment right (or left).</i>	<i>Right (or left) turn.</i>
	<i>Double march.</i>
	<i>Front turn. Halt.</i>

The detachment turns to its front when one yard clear of the gun wheel, and halts when in line with the axle-tree.

R.B.L. Ordnance (40-pr. and 7-inch).

Section II.

TO FORM DETACHMENT REAR FROM THE ORDER OF MARCH.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Right about turn.</i>
	<i>Double march.</i>
	<i>Halt. Front.</i>

2 and 3 close to the centre and wheel to their left, marking time when opposite the off wheel and two yards from it; as soon as the detachment has closed up it is halted and turned to the front.

TO FORM DETACHMENT FRONT FROM THE ORDER OF MARCH.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment front.</i>	<i>Double march.</i>
	<i>Halt. Front.</i>

No. 1 doubles out two yards in front of the near shaft, turns to his right, and gives "*Double march.*" 8 and 9, followed by the other numbers, double out. As soon as 8 is clear of the shafts he inclines towards 9. When 8 and 9 arrive in line with No. 1, they wheel to their left and mark time; when the detachment is closed up, No. 1 gives "*Halt. Front.*," turning to the front himself at the same time.

For shifts from travelling to firing trunnion holes, and the converse, which are similar to those for 40-pr. R.M.L. guns, *vide* page 95, *et seq.*, with the exception that the roller in the latter case is placed as near under the centre of gravity as possible.

For mounting and dismounting 40-pr. B.L. guns, *vide* page 322.

7-INCH R.B.L. GUNS.

DESCRIPTION.

These are of two patterns, the lighter being that first introduced.

	82-cwt. Gun.	72-cwt. Gun.
Calibre (or diameter of grip) ..	7 inches	7 inches
Nominal weight.	82 cwt.	72 cwt.
Preponderance	6 cwt. 3 qrs.	8 cwt.
Length { of barrel	95.5 inches	99.5 inches
{ of powder chamber ..	16 "	14.25 "
{ of shot chamber ..	9 "	9 "
{ total, nominal ..	120 "	118 "
Rifling { grooves, number ..	76	76
{ polygroove, uniform, 1 turn in 37 calibres.		

Section II.

R.B.L. Ordnance (7-inch).

CONSTRUCTION.

The 72-cwt. gun consists of—"A" tube or inner barrel; breech piece and "B" tube; trunnion ring; four coils.

The 82-cwt. gun differs from the above in having two additional coils, one in front of the vent slot, termed a "strengthening coil," and an additional coil in front of the trunnions.

PARTS.

The parts of these guns are similar to those of the 40-pr. R.B.L. gun (*vide* p. 296, 297), the only important difference being that the breech and vent piece in 7-inch guns are bushed with wrought iron instead of copper, the latter being not sufficiently hard.

RIFLING AND VENTING.

Same as 40-pr. R.B.L. (*vide* p. 297).

SADDLE.

This is of gun metal, and is screwed on to the gun in rear of the vent slot, for the vent piece to rest on.

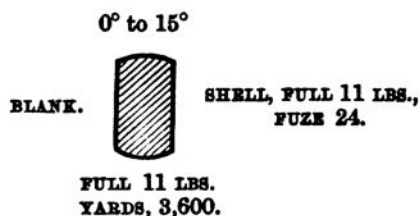
SIGHTING.

The guns are provided with two tangent and two trunnion sights.

The 72-cwt. gun has hexagonal gun-metal tangent sights, graduated from 0° to 10° , and screwed-in fore or trunnion sights.

The earlier patterns of tangent sights in both guns are "barrel-headed," the later patterns being the sliding leaf sights.

The 82-cwt. gun has a steel four-sided bar, and is now graduated as follows:—



The 82-cwt. gun has drop trunnion sights.

PROJECTILES.

Shot, case, filled with 74 8-ounce sand shot,	}	67 lbs.
clay and sand		
" drill, a recovered shell, with the lead	}	81 lbs. to 96 lbs. according to mark
coating slightly turned down ..		

R.B.L. Ordnance (7-inch).**Section II.**

Shell, segment, empty	98½ lbs.
„ „ filled	about 101 lbs. 10 ozs.
„ common, empty	about *83 lbs and 98 lbs.
„ „ capacity for bursting charge..	7 lbs. 10 ozs.

The case shot have three soft metal studs near the base to prevent them from entering too far into the bore; they are used against troops or boats. Segment shell are used against troops beyond the range of case shot, and common shell against shipping, earthworks, buildings, &c.

CHARGES.

Service, L.G. or R.L.G. powder, for 82-cwt. gun ..	11 lbs.
„ „ „ for 72-cwt. gun ..	10 lbs.
Saluting or exercise	7 lbs.

The service cartridge has a lubricator screwed into a socket, which is choked into the cartridge.

Primers for vent pieces are used with these guns.

FUZES.

Wood, time	{ 20-second B.L.O. for all shell.
	{ 9 „ „ „
	{ 5 „ „ „
Percussion	{ Pettman's G.S. for all shell.
	{ R.L., Mark II, „

TIN CUPS

Are always used to assist in closing the breech, and as a protection to the breech and vent piece bushes.

CARRIAGES.

The following carriages are used with these guns:—

Carriages, wood, sliding, casemate ..	Weight. 15 cwt.
„ „ „ dwarf	16½ cwt.
„ Moncrieff, with elevator, about	9 tons.
„ siege, for naval slide	14½ cwt.

The casemate and dwarf carriages are of the usual pattern for traversing platforms.

* For 82-cwt. gun only.

Section II.

R.B.L. Ordnance (7-inch).

For description of Moncrieff carriage, *vide* "Treatise on Military Carriages," 1876, p. 150.

The siege carriage is the naval carriage fitted with side-plate compressors.

The 7-inch gun of 72 cwt. is also occasionally mounted on the 10-inch S.B. of 86 cwt., rear chock carriage.

PLATFORMS.

Dwarf	Weight, 33 $\frac{3}{4}$ cwt.
Casemate	27 cwt.
Naval slide	26 $\frac{1}{2}$ cwt.
Moncrieff	4 tons 3 cwt.
Ground for naval slide ..	16 $\frac{3}{4}$ cwt.

DRILL WITH 7-INCH R.B.L. GUN ON TRAVERSING PLATFORM.

The detachment consists of 9 Nos., and falls in two deep.

TO TELL OFF.

<i>Officer.</i>	<i>No. 1.</i>
<i>Tell off.</i>	

At "*Tell off*," No. 1 (who is on the left of the detachment) takes a pace to his front, turns to his right, and numbers himself 1; the right-hand man of the rear rank numbers 2; the right-hand man of the front rank 3, and so on to the left.

After the detachment is told off, No. 1 falls in again on the left of the front rank.

The detachment is marched into the battery and halted in line, facing the parapet and to the left rear of the platform.

The detachment is now in the position of "*Detachment rear*."

TO TAKE POST UNDER COVER.

<i>Officer.</i>	<i>No. 1.</i>
<i>Take post under cover.</i>	<i>Right turn.</i>
	<i>Double march.</i>

R.B.L. Ordnance (7-inch).

Section II.

The detachment, stepping off, wheels to its left at the left corner of the platform; the front rank filing to the left of the gun, the rear rank to the right; 2 and 3 halting close to the parapet and near the mouth of the embrasure; 4 and 5 forming upon their right and left, and the whole turning to the right-about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 go to the cartridge store (6 outside) and 7 and 9 to the shell store (7 outside).

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, holds on to the preventor rope, and lays.

No. 2 runs up, sponges (if necessary), rams home, elevates, and traverses.

No. 3 runs up, removes safety pin or uncaps fuze, loads, rams home, elevates, and traverses.

No. 4 runs up, attends to breech screw, vent piece, and tin cups, attends to side arms, and supplies them to 2; and to elevating screw and coin in laying.

No. 5 runs up, attends to breech screw and vent piece, attends to the preventor rope, primes, makes ready, and fires.

No. 6 supplies 3 with cartridge, and brings up projectile.

No. 7 attends to fuzes and brings up projectile.

No. 8 attends to cartridge store and serves out cartridges to 6 with lubricators attached.

No. 9 attends to shell store, and issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

Officer.
Prepare for action.

No. 1.
Prepare for action.
Examine gun.

"Prepare for action."

The stores are brought up as follows:—

No. 1, sights, file for vent-piece, and preventor rope.

No. 2, 7-foot handspike, truck lever, iron shod lever, and assists 4 with side-arms.

No. 3, 7-foot handspike, truck lever, iron shod lever, and elevating screw removes apron and tampeons.

No. 4, side-arms and support; tin cups in pocket and extractor.

No. 5, primers in pocket, tubes in box, lanyard, oil can and hemp, and iron lever.

No. 6, two cartridge cases, which he takes to the cartridge store, bucket filled, and brush (two dummy cartridges for drill).

(A. M.)

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Section II.

R.B.L. Ordnance (7-inch).

No. 7, fuzes, fuze, and shell implements, one set of luff tackle, and one shell bearer. He obtains the fuze boxes from 9, having ascertained from No. 1 the nature of fuzes required, satisfying himself as to the correctness of fuzes and fuze implements.

No. 8 prepares to issue cartridges.

No. 9, one set of luff tackle and a brush; prepares to issue shells, tubes and fuzes; he examines the shells carefully, cleaning them if necessary, and removing burrs; he loosens the fuze hole plugs of shells that will be first issued.

The stores having been brought up, No. 1 will satisfy himself that the foresights fit properly on the gun, that the deflection leaves of the hind sights work easily, and that the platform is properly swept; he attaches the preventor rope to the carriage, and, assisted by 3, takes two turns with it round the bollard, the running end coming off to the left at the top. He receives reports from the Nos. responsible of any irregularity or deficiency in connection with the gun, ammunition, and stores. He ascertains that the breech fittings are properly put on and well oiled.

Should the indicator ring require adjusting, he adjusts it in the following manner:—The vent piece is screwed home as it would be for firing. The lever and tappet ring are then removed. The indicator ring is passed over the octagonal part of the breech screw, so that the arrow marked on it, or raised line, will correspond with a similar mark on the gun. If the arrows cannot be made to coincide, the indicator ring is to be so placed that the arrow on it will be to the left of the mark on the gun, as close as the cogs of the indicator ring will permit. The tappet ring and lever are then replaced. They ought to be put on so that the lever ball will be resting on a cam of the tappet ring on the right side of the gun in a convenient position for No. 4 to give two taps after the breech is screwed up; 4 depresses the gun about 3°.

The side arms are laid down to the right of the gun, and parallel to it, heads to the front, resting on the support provided, sponge next the gun, and in line with the breech when the gun is run up.

The sponge bucket near the sponge head.

The handspikes and iron shod levers are laid down bevelled side uppermost, the handspikes next the gun, the truck levers between them, the whole with their points to the front.

The tin cup extractor and lever are placed in loops on the carriage.

If the indicator and tappet rings, with their keep pins, have been detached, 4 and 5 bring them up.

4 sees that the elevating screw is properly oiled.

5 straps the tube box round his waist on the right side, coils up the lanyard, and places the bight of it under the tube box strap. He fills the tube box with friction tubes, which he procures from 9.

R.B.L. Ordnance (7-inch).

Section II.

The standing blocks are hooked by 7 and 9 to the rear eye bolts of the platform, the tackles rounded in, and the falls coiled down.

"Examine gun."

Nos. 4 and 5 take a purchase with their handspikes over the cheeks and under the breech, and bear down; 2 double man's 4's handspike. The coin is withdrawn, and the elevating screw put in by 3, No. 1 holding up the stool bed with an iron shod lever applied over the bottom step of the carriage. No. 1 gives "*Lower*," when 4 and 5 withdraw their handspikes and lay them down. 4 and 5 then mount up on the platform, and open the breech; 4 by taking the lever handle in his right hand, back up, and swinging it round a half circle towards him from cam to cam, 5 in his left hand, back up. This will strike a blow hard enough to move the screw, which is then unscrewed two turns, and the vent piece is released; 4 and 5 lift the vent piece out of the slot, and lay it on the saddle on the top of the breech coil. At "*Clear*," from No. 1 they drop in the vent piece; 5 takes the lever handle in his left hand, back up, and turning the handle towards him, with 4 screws up the breech screw until it is home. 4 and 5 then go under cover.

If No. 1 gives "*Sponge out*," 2 mounts up, taking the sponge with him, and sponges the gun out; at "*Clear*," 4 and 5 act as before detailed, 2 passes the sponge over his head as he turns left about, replaces it, and goes under cover.

No. 1 then directs 5 to fire a tube.

TO LOAD.

<i>Officer.</i>		<i>No. 1.</i>
<i>Range</i> —yards.		<i>Run up.</i> <i>Halt.</i>
<i>With</i> —load.		<i>With</i> —load.

"Run up." No. 1 takes in the slack and holds on the preventor rope; 2, 3, 4 and 5 take up the truck levers; 2 and 3 raising the small ends to enable 4 and 5 to hook the points to the eyebolts. When this is done 2 and 3 haul down the small ends by means of the ropes; 4 and 5 place the pawls; 4 goes under cover; 5 holds on to the preventor rope behind 1; 2 and 3 guide the levers whilst the carriage is in motion; 1 and 5 ease off hand over hand, and hold on when the mark on the preventor rope comes over the bollard.

"Halt." When the gun is in its proper position No. 1 gives "*Halt*;" 2 and 3 bear down the small ends of the levers; 4 and 5 throw back the pawls; 2 and 3 allow the small ends of the levers to rise gently, manning the ropes when the levers are out of reach. When the rear of the carriage rests on the platform, the levers are unhooked, withdrawn, and laid down outside the handspikes by 2, 3, 4, and 5, who go under cover.

(A. M.)

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Section II.

R.B.L. Ordnance (7-inch).

"*Load.*" 2 and 3 as soon as 4 and 5 have lifted out the vent-piece, mount on the side pieces by the steps and place themselves in a position for sponging or loading.

They lift the shell in the bearer to the bore, into which 3 forces it with his right hand, having first withdrawn the safety pin or uncapped the fuze; 2 then receives the rammer from 4 and, assisted by 3, rams home the projectile, their outward hands back under, inner hands back up; 3 then turns to his right, takes the cartridge out of the case, places it in the bore, and goes under cover; 2 presses the cartridge gently home, withdraws the rammer, turns to his left about, gets down, replaces the rammer, and goes under cover.

Should "*Sponge out*" be given by No. 1, 2 receives the sponge from 4, introduces it into the bore and sponges out in two motions; he then withdraws the sponge, cleaning the chamber well, and hands it back to 4.

4 and 5 mount up, unscrew the breech screw and lift the vent-piece on to the saddle, using the iron lever if necessary; 4 removes the old tin cup with the extractor, and goes to the sidearms, lifts the sponge (if required) with his left hand back under, turning to the right about as he does so, and hands it to 2, waits for it, replaces it, and then takes up the rammer in the same way he did the sponge, hands it to 2 and goes under cover, 5 unhooks and takes in the slack of the preventor rope.

As soon as the gun is loaded 4 and 5 mount up, 4 passes a tin cup down the slot, edge to the front, and presses it into the bore; 5 primes the vent piece. They then drop in the vent piece, and screw up the breech screw as before explained, 4 (for additional security) placing both hands on the top of the lever ball, and giving two smart taps; 4 and 5 then go under cover.

6 and 7 bring up the projectile in bearer, 6 carrying the cartridge case in his right hand; the bearer is placed on the platform on the right of 3; 7 removes it when the shell has been placed in the bore by 2 and 3; 6 uncovers and raises the cartridge case to enable 3 to withdraw the cartridge.

TO LAY THE GUN (*vide* p. 336).Officer.No. 1.*Elevate.**Lower. Coin.**With screw elevate. Halt.**Depress. Halt.**Trail right. Halt.**Trail (left). Halt.*

No. 1 looking over his sights gives "*Elevate*," then "*Lower*," and when the gun is at the required elevation, "*Coin*." If a slight amount of elevation or depression is required, he gives "*With screw*," "*Elevate*," or "*Depress*."

R.B.L. Ordnance (7-inch).

Section II.

"*Elevate*," 2 and 3 take up their handspikes and step forward in line with the breech, place their handspikes, bevels down, over the steps of the carriage and under the breech, and bear down; 5 double man's 3's handspike; at "*Lower*," they allow the small ends to rise gently; at "*Coin*," they withdraw their handspikes and step outwards; 4 withdraws the coin as soon as 2 and 3 elevate, and at "*Coin*" forces it sharply home. If the order is "*With screw*," "*Elevate*," or "*Depress*," 4 works the screw until "*Halt*" is given, and 2 and 3, laying down their handspikes, take up the iron shod levers, placing themselves ready to traverse. As the platforms on which the gun is mounted are pivoted in front, centre, or in rear, the position taken up by 2 and 3 differs according to the manner in which the platform is pivoted.

Nature of Pivot.

"A," (under the muzzle of the gun when run up).

*Position of Nos. 2 and 3.**"Trail right."*

2 stands facing to the rear with the point of his lever resting on the rear racer; at "*Halt*" he scotches the rear truck his own side with the lever.

3 stands facing to the rear and applies the point of his lever under the left rear truck of the platform, both hands back up and heaves the platform over to the right, taking short quick purchases.

"Trail left."

The numbers work in the opposite directions.

Pivot "B" (under the front part of the platform).

As with A pivot.

"Trail right."

3 works as with pivot "A;" 2 takes up his position at the front truck on his own side, and works over the front of the platform to the left. At "*Halt*," 2 withdraws his lever and with it scotches the rear truck.

Pivot "C" (in the centre of the platform).

"Trail left."

3 works the front truck, and 2 the rear, 3 scotches the rear truck at "*Halt*."

Section II.

R.B.L. Ordnance (7-inch).

Pivot "D" (at an intermediate point between the centre of the platform and the rear truck).	}	<p><i>"Trail right or left."</i></p> <p>2 and 3 work the front truck, 2 heaving the front of the platform over to the left in the first case, 3 the front to the right in the second.</p>
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Pivot "E" (in front of the rear block).	}	As with "D" pivot.
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Pivot "F" (in the rear of the rear block).	}	As with "D" Pivot.
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With platforms pivoted at "A" or "B;" at *"extreme right"* (or *left*), 2, 3, 4 and 5 push over the rear of the platform in the direction ordered.

When traversing tackle is used, at *"hook traversing tackle,"* 4 and 5 hook the double blocks to the rings or holdfasts prepared for them; 2, 4, and 3, 5, haul on the tackle, or ease off at *"Trail right"* (or *left*), so as to move the platform in the direction required.

If the tackle when hooked hinders the service of the gun, the double blocks are removed by 4 and 5, or the single ones by 2 and 3, as may be directed by No. 1.

Should no order to fire be given when the gun is laid, No. 1 gives the word *"Under cover."*

TO MAKE READY AND FIRE.

At *"Ready,"* 2 and 3 withdraw their levers, and place them, bevels up, as scotches under the trucks, 2, 3, and 4 then go under cover. 5 presses a tube into the vent, descends from the platform, passes the lanyard through the rear eye bolt of the carriage, and stands ready to fire, facing the gun. At *"Fire"* he draws the lanyard strongly towards him without a jerk, replaces it under his belt, and goes under cover.

TO RUN BACK AND UNLOAD.

<i>Officer.</i> <hr style="width: 50px; margin: 0;"/>	<i>No.</i> <hr style="width: 50px; margin: 0;"/> <i>Run back.</i> <i>Halt.</i> <i>Examine gun.</i>
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"Run back," 4 slackens the compressor if the carriage is fitted with one.

The truck levers are applied as in running up; No. 1, standing between the cheeks, holds the small ends of the truck levers and guides them; 4 and 5 overhaul the tackle and hook the front blocks to the front eye-bolts on the carriage. All the numbers, except No. 1, man the falls on their respective sides, and at *"Heave,"* haul the gun back.

R.B.L. Ordnance (7-inch).

Section II.

"Halt." When the gun is run far enough back, No. 1 hauls down the levers by the ropes till the pawls fall; the levers are then allowed to come up, No. 1 rising with them. The front blocks are unhooked by 4 and 5 who carry them to the rear, lay them down clear of the racers, and coil down the end of the fall. No. 1 takes in the slack of the preventor rope; 2, 3, 4, and 5 unhook the truck levers and lay them down.

"Examine gun," 4 and 5 mount up on the platform and take out the vent piece as before detailed in **"Prepare for action;"** 2 forces the drill projectile and cartridge through the bore with the sponge; 6 and 7 receive them at the muzzle and carry them to the rear. 4 and 5 replace the vent piece, and screw up the breech screw.

TO CEASE FIRING AND REPLACE STORES.

<u>Officer.</u>	<u>No.</u>
<i>Cease firing.</i>	<i>Elevate.</i>
<i>Replace stores.</i>	<i>Lower. Coin.</i>
	<i>Replace stores.</i>

"Elevate." "Lower." "Coin."

4 and 5 take a purchase with handspikes as detailed in **"Prepare for action,"** 3 taking out the elevating screw and replacing the pedestal or coin, No. 1 assisting as before.

The gun is laid **"Under metal."**

"Replace Stores," the stores are replaced by the numbers who brought them up.

TO FORM DETACHMENT REAR.

<u>Officer.</u>	<u>No. 1.</u>
<i>Detachment rear.</i>	<i>Outwards turn.</i>
	<i>Double march.</i>
	<i>Halt.</i>
	<i>Front.</i>

"Detachment rear," No. 1 doubles to the left rear of the platform, faces to the left, and gives the order **"Outwards turn,"** 2 and 4 turn to their left, 3 and 5 to their right.

"Double march," 4 and 5, followed by 2 and 3, wheel to the right and left, and when clear of the platform to the right, and round No. 1's left shoulder, 6, 7, 8 and 9 coming up into their places; when 2 and 3 have passed him No. 1 gives **"Halt," "Front,"** and changes his flank by the rear.

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change rounds.</i>	<i>Change rounds.</i>

Section II.

R.B.L. Ordnance (7-inch).

In changing rounds No. 2 becomes 4; 4, 1; 1, 9; 9, 8; 8, 7; 7, 6; 6, 5; 5, 3; 3, 2.

DRILL WITH 7-INCH R.B.L. GUNS ON
NAVAL SLIDES.

The same stores are brought up as for traversing platforms, except that no truck or iron shod levers are required. 2, 3, 4, and 5, each provide a 7-foot handspike.

The gun is served as if on a traversing platform, the slide is traversed and the gun run up as with R.M.L. guns similarly mounted.

DRILL WITH 7-INCH R.B.L. GUN ON MONCRIEFF
CARRIAGE.

The detachment, consisting of nine Nos., is told off, and takes post under cover, as with the same gun mounted on a traversing platform.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, attends to the brake in running up, and lays.

No. 2 sponges, places projectile in bore, rams home, attends to lever if required, and elevates.

No. 3 removes safety pin, or uncaps fuze, loads, rams home, attends to lever if required.

No. 4 attends to breech screw, vent piece, and tin cups, attends to sidcarms, supplies them to 2, traverses, attends to lever if required.

No. 5 attends to breech screw and vent piece, primes, depresses the gun for loading, elevates previous to running up (about 1°), traverses, attends to lever if required, makes ready, and fires.

No. 6 supplies 3 with cartridges, and brings up projectile.

No. 7 attends to fuzes and brings up the projectile.

No. 8 attends to cartridge store, serves out cartridges to 6, with lubricators attached.

No. 9 attends to shell, store, issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

As with the gun on a traversing platform, except no preventor rope, handspikes, truck levers, or iron shod levers are required. No. 5 provides a long lanyard.

2 and 3 bring up an iron-pointed lever each, which they lay down on each side of the gun.

R.B.L. Ordnance (7-inch).

Section II.

Tackle will be necessary to run the gun back.* Two sets of heavy gun tackles are brought up by 6 and 7.

The sponge and rammer are laid down on the right of the gun, close to the parapet, heads towards the muzzle, the shell extractor and wadhook outside the pit.

At "*Examine gun*," same as at 7-in R.B.L. on a traversing platform, and 5 attends to the elevating wheel and depresses until the gun is in a convenient position for loading.

TO LOAD.

No. 1 at "*Load*" gets the gun into a convenient position, 5 depresses if necessary.

After the loading is completed, 5 gives 1° or more of elevation, as shown on the arc.

TO RUN UP.

Before running up, No. 1 will give the caution "*Stand clear*," then holding the brake he allows the gun to run up.

He must be very careful not to let it escape from his control, and, on the other hand, he must not check it too soon. Should the latter be the case, No. 1 gives "*Work levers*," 2 and 3 fix the latches, and work their levers, small ends to the rear; 2 and 4 man the right, 3 and 5 the left lever; No. 1 will give "*Down*," "*Fresh purchase*," "*Halt*," as required.

When the gun is up, No. 1 will mount up the ladder to lay it, 2 and 3 slackening the latches and unshipping the levers; 4 and 5 man the traversing handle.

TO LAY THE GUN.

4 and 5 traverse.

2 elevates or depresses.

The gun may be laid without exposing any number, No. 1 using a reflecting sight, or elevating in accordance with the graduations on the elevating arc or trunnion pointer, and traversing to marks previously made on the racers.

TO MAKE READY AND FIRE.

When No. 1 has laid the gun at "*Ready*," 5 mounts up and drops the tube into the vent, throwing the lanyard clear of the carriage, and comes down.

When the gun is laid from below, No. 5 makes ready before the gun is run up. As soon as he has fired, he coils up the lanyard and replaces it under his belt.

* Two heavy gun tackles allowed for each gun mounted singly, or for every two guns when together.

Section II.R.B.L. Ordnance (7-inch and 40-pr.).

TO UNLOAD AND RUN BACK.

(For drill purposes extra men will be required.)

To run back, 2 and 3 fix the latches and work their levers, small ends to the front, and bear down, double-manned by 4 and 5. No. 1 gives "*Down*," "*Fresh purchase*," "*Halt*," as required, Tackles to be hooked by 4 and 5, assisted by 6 and 7, and manned by all available numbers.

Unloading should be effected when the gun is run back.

TO CEASE FIRING AND REPLACE STORES.

TO FORM DETACHMENT REAR.

TO CHANGE ROUNDS.

As with 7-inch R.B.L. on traversing platform.

DRILL WITH 7-INCH R.B.L. GUNS ON REAR
CHOCK CARRIAGES.

In preparing for action, No. 1 brings up a roller handspike, which he lays down in rear.

The stores detailed for a gun mounted on a traversing platform are brought up by the several numbers, but the truck and iron shod levers and preventor rope are not required.

A tackle is brought and arranged by Nos. 8 and 9 for running back.

The gun is served as when mounted on a traversing platform.

TO MOUNT OR DISMOUNT A 40-PR. B.L. GUN ON
OR FROM A TRAVELLING SIEGE CARRIAGE BY
LONG SKIDS UP OR DOWN THE REAR.

The stores required and manner of carrying out these operations are the same as described for the 40-pr. R.M.L. (pages 108 to 110), with the following exceptions:—

TO MOUNT THE GUN.

It is unnecessary to receive the trunnions on handspikes in the trunnion holes.

TO DISMOUNT THE GUN.

The muzzle being borne down, the long skids are placed at once under the breech without raising the gun on to the points of handspikes in the trunnion holes in the first instance.

N.B.—The gun can be mounted or dismounted by one detachment.

S.B. Ordnance (Howitzers and Guns).

Section III.

S.B. ORDNANCE.

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DRILL WITH S.B. GUNS.

The detachment consists of nine numbers, and the drill is the same as with the 64-pr. R.M.L. gun, with the following exceptions:—

In preparing for action no shell extractor is required. Wedge wads are not used with S.B. guns. When junk or grummet wads are used they are supplied by 5.

At the 8-inch, 10-inch, and 68-pr. guns 3 assists 2 to sponge, then slews his body to the right and receives a cartridge from 6 (the rest of his duties as with 64-pr. R.M.L.).

If shells are used they are brought up in a shrapnel shell box, without a lid, fuze downwards, by 6 and 7; 6, who is on the right, also carrying a filled cartridge case in his right hand.

The box is passed under the muzzle by 7 to 4.

With their inward hands 2 and 3 lay hold of the rope handles, their outward hands supporting the box; they raise it as high as the muzzle and capsize it smartly, throwing the shell into the bore. 7 takes the box to the rear. 6 the empty cartridge case.

In firing 68-pr. solid shot, the shot is placed on a bearer and passed under the muzzle by 7, and is lifted in by 2 and 3.

In unloading, where solid shot have been used, 4 and 5 at "Unload" take up their handspikes and apply them at once under the breech, to let the shot roll out of the bore, lowering it again as soon as the shot has been received on a bearer and placed on the head of the platform by 2 and 3, and replacing their handspikes.

DRILL WITH S.B. HOWITZERS.

10-INCH AND 8-INCH HOWITZERS.

The drill is the same as with S.B. guns, except that No. 2, after sponging, reverses the sponge, and rams home. Should reduced charges be used as in ricochet firing, the cartridges must

Section III.

S.B. Ordnance (10-inch and 13-inch Mortars).

be either lengthened with wads or rammed home separately, the same rule applies with all shell guns.*

At "*Ready*" the men step one pace from the merlon in order to be clear of the explosion, or if there be no merlon, Nos. 2 and 3 take an oblique pace to the rear.

Howitzers on perch-trail carriages are provided with friction levers, which bear on the naves of the wheels; chocks also are fitted over the trucks, in order to check the recoil.

After the howitzer is run up and traversed, "*Fix levers and chocks*" is given, when Nos. 4 and 5 apply their handspikes in the straps and under the cheeks of the carriage, and No. 1 puts in the pins or hooks the chains.

After the handspikes are taken up for running back, "*Unfix levers*" is given. Nos. 4 and 5 apply their handspikes as before. No. 1 withdraws the pins.

TO UNLIMBER AND LIMBER UP HOWITZERS ON
PERCH TRAIL CARRIAGES.

"*Prepare to unlimber.*" No. 1 unhooks the keep-chain, and 8 and 9 the draught chain; 2 passes a handspike under the perch to 3, to be double-manned by 4 and 5; 4 and 5 place handspikes under the wheels as scotches, 4 in front, 5 in rear. Nos. 1, 6, 7 then stand to the trail, 2, 3, 4, and 5 man the handspikes, 8 and 9 stand to the splinter bar, 10 to the shafts.

"*Unlimber,*" the Nos. at the trail raise it, until it is clear of the pintail; No. 1 gives "*Limber. Drive on,*" and the limber is removed a short distance to the rear. Nos. 1, 6, and 7 stand to the trail eye, whilst the other Nos. shift the handspike towards the trail plate. The trail is then lowered carefully and steadily to the ground.

Limbering up is the converse of this, but caution is required that the 8-inch howitzer be not turned completely over.

10-INCH OR 13-INCH L.S. MORTARS ON
STANDING BEDS.

The detachment consists of 9 Nos., and is told off as with M.L. guns.

TO TAKE POST AT THE MORTAR.

<i>Officer.</i>	<i>No. 1.</i>
<i>Take post at the mortar.</i>	<i>Right turn.</i> <i>Double march.</i>

* At drill with howitzers and shell guns it is necessary to use either a very long dummy cartridge, or to ram home several junk wads before commencing to drill, otherwise the rammer-head and bottom of the shells are apt to get fixed in the chamber.

S.B. Ordnance (10-inch and 13-inch Mortars).

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"Right turn."—The detachment files on to the mortar, 2 and 3 halting in line with the muzzle and one yard clear of it, 4 and 5 the trunnions, No. 1 follows in rear of the detachment and halts in rear of the mortar, 6 and 8 go to the cartridge store (6 outside), 7 and 9 to the shell store (7 outside).

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes and lays.

No. 2 sponges, assists to put in shell at the 13-inch, runs up, and traverses.

No. 3 plants pointing rods, puts in cartridge, assists to put in shell at the 13-inch, uncaps the fuze when in the bore, runs up and traverses.

No. 4 attends to sponge and supplies it to 2, wipes shell, and at the 13-inch assists to put it in, runs up, and traverses.

No. 5 attends to vent, runs up, traverses, makes ready, and fires.

No. 6 supplies 3 with cartridges, brings up and puts in shell.

No. 7 attends to fuzes, brings up and puts in shell.

No. 8 attends to cartridge store, weighs and serves out cartridges to 6.

No. 9 attends to shell store, issues shells, tubes, and fuzes.

TO PREPARE FOR ACTION.

Officer.

Prepare for action.

No. 1.

Prepare for action.

No. 1 provides a plummet with line attached and a piece of chalk.

No. 2, sponge and handspike

No. 3, pointing rods and handspike, also removes muzzle cap.

No. 4, handspike, sponge bucket filled, and sheep skin.

No. 5, handspike, tubes in box, lanyard, pricker, and vent server.

No. 6, cartridge case.

No. 7, fuzes and fuze implements.

No. 8 prepares to weigh out cartridges.

No. 9, shell implements, and beam or hand hooks.

The sponge is laid on the ground to the right of the mortar, head to the rear, resting on the muzzle cap; the handspikes as with guns on standing carriages; the pricker on the left trunnion; sheep skin to right of the muzzle, clear of No. 2. The cartridge case is with No. 8 at the cartridge store. 5 drifts the vent and places the vent server in the vent.

No. 1 satisfies himself that the vent and bore are clear, and strikes a chalk line on the mortar.

Section III.

S.B. Ordnance (13-inch Mortar).

TO PLANT THE POINTING RODS AND LAY THE MORTAR.
(*Vide* p. 339.)

TO LOAD.

<i>Officer</i>	<i>No. 1.</i>
<i>Range—yards.</i>	<i>Run up.</i>
<i>With—load.</i>	<i>Halt.</i>
	<i>Muzzle (right).</i>
	<i>" (left).</i>
	<i>Heave.</i>
	<i>Halt.</i>
	<i>Crosslift (right).</i>
	<i>" (left).</i>
	<i>Heave.</i>
	<i>Halt.</i>
	<i>With—load.</i>

Mortars are laid before loading.

"*With—load.*"—No. 1 moves the mortar, until the chalk line on the mortar is in line with the two pickets. He places himself in rear of the platform so as to cover the pickets, holding the plummet line with his right hand, in front of, and at a little distance from his right eye (his left hand steadying the plummet), and gives "*run up,*" when the handspikes are applied under the running up bolts as with standing carriages. "*Halt.*" All turn to the rear, handspikes across the body, points on the platform towards the mortar.

In all traversing the men stand between the parapet and handspikes.

"*Muzzle right.*"—No. 2 crosses to the left side of the bed, shifting the small end of his handspike into his right hand, and takes a purchase under the right front horn: 3, a purchase under the left front horn; 4, a purchase under the right rear horn; 5 crosses over to the right side of the bed and takes a purchase under the left rear horn. No. 1 giving "*Heave,*" and "*Halt.*"

"*Muzzle left*" is the converse of "*Muzzle right.*"

"*Cross lift right.*"—Nos. 3 and 5 take a purchase under their respective horns: 2 and 4 shift over to the left side of the mortar, and take a purchase under their respective horns also; No. 1 giving "*Heave,*" "*Halt.*"

"*Crosslift left.*"—Nos. 2 and 4 under the horns on their own sides; Nos. 3 and 5 shift over; No. 1 giving "*Heave,*" "*Halt.*"

"*Load.*"—The handspikes are laid down, as with M.L. guns, No. 1 sends by 6 to 8 the proper weight of charge, and also gives 7 the length of fuze.

No. 2 places himself in position for sponging, receives the sponge with his left hand at the centre, back down, brings the sponge in line with the axis of the bore, presses the head to the

S.B. Ordnance (13-inch Mortar).

Section III.

bottom, bending over on the left knee, and supporting the stave with his left hand, gives it two half turns with his right. He then grasps the stave firmly with both hands, wipes the whole surface of the bore from breech to muzzle, gradually bending over the right knee and straightening the left, and having withdrawn the sponge, returns it to No. 4. At the 13-inch, he assists to lift the shell into the bore, mounting on the bed for that purpose.

No. 3 turns to his left, receives a cartridge from 6, turns to his right-about, and places it in the bore, pressing it well home, and taking care that the seam does not come under the vent. At the 13-inch, he assists to lift the shell into the bore, mounting on the bed for that purpose. When the shell is in the bore he uncaps the fuze. When carcasses or light balls are fired, he uncovers the holes and loosens the priming.

No. 4 supplies and replaces the sponge as with a M.L. gun, then picks up the sheep skin and, standing in front of the muzzle, wipes the bottom of the shell or carcass and assists to put it in, taking care that the fuze is in the centre. He then replaces the sheep skin.

Nos. 6 and 7 bring up a shell (with the beamhooks at the 13-inch, handhooks at the 10-inch), 6 on the right, 7 on the left, 6 carrying the cartridge case in his right hand and leaving it in front of 3. They come up on the left side, wheel to the right-about, and front the muzzle. After the shell has been wiped, they place it in the bore, assisted by 4, and at the 13-inch by 2 and 3 as well, 6 carries the empty cartridge case, and 7 the beam or hand hooks, to the rear; 8 having weighed out a charge in accordance with No. 1's directions, issues it to 6.

TO MAKE READY AND FIRE.

<i>Officer.</i>	<i>No. 1.</i>
<i>Fire one round.</i>	<i>No. — ready.</i>
<i>"Ready."</i>	<i>No. — fire.</i>

Nos. 2 and 3 take two oblique paces outwards to the rear to be clear of the explosion.

No. 5 presses a tube into the vent, keeping his right hand on a level with the vent, and at "*Fire*" draws the lanyard strongly towards his body without a jerk, replaces it under his belt, and takes post. As soon as the mortar is fired he steps in at once, clears the vent, and replaces vent server. 2 and 3 after the mortar is fired, resume their positions.

TO RUN BACK AND UNLOAD.

<i>Officer.</i>	<i>No. 1.</i>
	<i>Run back.</i>
	<i>Heave.</i>
	<i>Halt.</i>
	<i>Unload.</i>

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S.B. Ordnance (8-inch Mortar).

After the vent has been drifted, 2, 3, 4, and 5, take up their handspikes and run the mortar back.

No. 1 gives "*Heave.*" At "*Halt,*" the handspikes are laid down and the Nos. take post.

"*Unload.*"—The same Nos. who loaded reverse the operation. With the 13-inch a drag rope, provided for the purpose by No. 8, may be hooked to a hand hook applied to one of the lugs of the shell and manned by all the Nos. The shell is hauled out by a sudden jerk, and falls clear of the platform.

TO CEASE FIRING AND REPLACE STORES.

<i>Officer.</i>	<i>No. 1.</i>
<i>Cease firing.</i>	<i>Cease firing.</i>
<i>Replace stores.</i>	<i>Replace stores.</i>

The stores are replaced by the numbers who brought them out.

TO FORM DETACHMENT REAR AND CHANGE ROUNDS.

As with the 64-pr. M.L.R. gun, only in "*Detachment rear*" No. 1 gives "*Right about turn*" instead of "*Outwards turn.*"

8-INCH MORTAR ON STANDING BED.

The detachment consists of 6 Nos., and is told off as with M.L.R. guns.

In taking post 2 and 3 halt in line with the muzzle, 5 the vent, 4 goes to the shell store, 6 to the cartridge store.

GENERAL DUTIES.

No. 1 commands, directs, or superintends boring and fixing fuzes, lays, hands the sponge to 2, and replaces it.

No. 2 sponges, wipes shell, runs up, and traverses.

No. 3 plants pointing rods, supplies himself with and puts in cartridge, uncaps the fuze, runs up, and traverses.

No. 4 bores and fixes fuzes, prepares, brings and puts in shell.

No. 5 attends to the vent, makes ready, and fires.

No. 6 attends to the cartridge store, weighs and serves out cartridges to 3.

TO PREPARE FOR ACTION.

<i>Officer.</i>	<i>No. 1.</i>
<i>Prepare for action.</i>	<i>Prepare for action.</i>

No. 1 provides a plummet with line attached, and a piece of chalk and sponge bucket filled.

S.B. Ordnance (8-inch Mortar).

Section III.

- No. 2, sponge and handspike, and sheepskin.
 No. 3, pointing rods, handspike, also removes muzzle cap.
 No. 4, fuze, fuze and shell implements.
 No. 5, tubes in a box, lanyard, pricker, and vent server.
 No. 6, cartridge case, and prepares to weigh out cartridges.

TO LOAD.

The mortar is served in a similar way to the 10-inch.

In running up or back 2 and 3 only apply their handspikes.

At "*Cross-lift*" (*right*) (*left*) they apply their handspikes under the horns on that side towards which the mortar has to be traversed; 2 working in front, 3 in rear.

At "*Muzzle right*" 2 applies his handspike under the right rear horn, and 3 his under the left front horn.

"*Muzzle left*" is the converse of "*Muzzle right*."

In loading No. 1 supplies and replaces the sponge, 2 after sponging wipes the shell, 3 doubles to the rear for the cartridge, brings it up and places it in the bore, 4 brings up the shell, puts it in, 3 takes back the empty cartridge case.

TO RUN BACK AND UNLOAD.

TO CEASE FIRING AND REPLACE STORES.

TO FORM DETACHMENT REAR.

As at the 10-inch.

TO CHANGE ROUNDS.

<u>Officer.</u>	<u>No. 1.</u>
<i>Change rounds.</i>	<i>Change rounds.</i>
2 becomes 4; 4, 1; 1, 6; 6, 5; 5, 3; 3, 2.	

ROYAL AND COEHORN MORTARS.

The detachment consists of 4 Nos.

GENERAL DUTIES.

No. 1 commands, lays, attends to vent, makes ready, and fires.

No. 2 sponges, and wipes shell.

No. 3 plants pointing rods, prepares shell, brings up and puts in cartridges and shell, and uncaps fuze.

No. 4 attends to the cartridge store, weighs, and serves out cartridges to 3.

Section III.

S.B. Ordnance (8-inch Mortar).

8-INCH, 10-INCH, AND 13-INCH MORTARS ON
TRAVELLING BEDS.

The detachments are the same as for mortars on standing beds. The service is almost the same, but the mortars are laid by traversing at the end of the perch.

The side arms are carried strapped on the beds.

For the purposes of unlimbering and limbering up, three drag-ropes are required with the 13-inch and 10-inch, and two with the 8-inch, four 6-foot handspikes with the 8-inch. A lifting jack is strapped to the perch of the 13-inch for the operation of limbering up, for which it is desirable to provide two oak skids, 3' x 6" x 9," and two 4-foot oak planks.

8-INCH MORTAR. (SIX NUMBERS.)

TO UNLIMBER.

*Officer.**Unlimber.**No. 1.**Prepare to unlimber.**Lift.**Limber, drive on.**Lower.**Off wheels.**Right the bed.**Heave.**Take post.*

No. 1 gives "*Prepare to unlimber*," and unkeys, 2, 3, 4, and 5 stand to the perch. No. 1 gets a drag-rope ready to hook to the perch eye. 6 places himself between the shafts. The wheels being scotched with handspikes, that of 2 in front, 3 in rear. "*Lift*." The perch is lifted carefully off the pintail, and No. 1 makes fast the drag-rope. "*Limber, drive on*." 6 moves forward a few yards with the limber, and lowers the shafts. The whole of the Nos. man the drag-rope, and at "*Lower*" ease off carefully till the mortar rests on its muzzle. "*Off wheels*." 2 and 4 remove the right wheel and lay it down, dish down, two yards to the right, 3 and 5 the left one in the same way, 1 and 6 attending to the linchpins and washers, 1 on the left and 6 on the right.

"*Right the bed*." All the Nos. heave well on the drag-rope and let the bed fall on to the ground. No. 1 casts off the drag-rope, and the detachment takes post.

S.B. Ordnance (10-inch Mortar).

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TO LIMBER UP.

<u>Officer.</u>	<u>No. 1.</u>
<i>Limber up.</i>	<i>Prepare to limber up.</i>
	<i>Lift and heave.</i>
	<i>On wheels.</i>
	<i>Limber up.</i>

"*Prepare to limber up.*" 6 places two handspikes on the ground, about 6 inches in rear of the perch eye, as a fulcrum for the handspike of 2, who, assisted by 3, thus raises the bed high enough for 4 to place his handspike under it. This raises the perch sufficiently high for the bed to be lifted as follows:—2 passes a handspike under the perch to 3, double-manned by 4 and 5. Nos. 1 and 6 each make fast a drag-rope to the perch eye, 1 passing his to the front, 6 to the rear. "*Lift and heave,*" 2, 3, 4, and 5 lift at the handspike. Nos. 1 and 6 haul on the front drag-rope till the bed is vertical; the handspike Nos. when they can no longer lift, fall back on to the rear drag-rope, and ease off till the muzzle rests on the ground.

"*On wheels.*" The Nos. that took them off replace them. "*Limber up.*" The perch is hauled down by the whole of the Nos., 2 and 3 first placing handspikes to receive the wheels when they touch the ground. 2, 3, 4 and 5 steady the perch while the limber is backed by 6. No. 1 casts off the drag-ropes, and keys up; the detachment then forms the order of march. No. 1 in line with the point of the off shaft, 2 and 3 with the axletree of the mortar, 4 and 5 with the centre of the perch, and 6 with the splinter bar.

10-INCH MORTAR. (NINE NUMBERS.)

TO UNLIMBER.

<u>Officer.</u>	<u>No. 1.</u>
<i>Unlimber.</i>	<i>Prepare to unlimber.</i>
	<i>Lift.</i>
	<i>Limber, drive on.</i>
	<i>Lower.</i>
	<i>Off wheels.</i>
	<i>Right the bed.</i>
	<i>Heave.</i>
	<i>Take post.</i>

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S.B. Ordnance (10-inch Mortar).

"Prepare to unlimber." No. 1 unkeys the pintail, 2 and 3 remove the drag-shoe, 4 and 5 scotch the wheels, 2, 3, 4, 5, 6, and 7 then stand to the perch.

Nos. 1 and 8 each have a drag-rope ready to hook to the perch eye. 9 places himself in the shafts.

"Lift." Nos. 2, 3, 4, 5, 6, 7 raise the perch carefully.* 9 moves the limber a few yards to the front.

Nos. 1 and 8 come up and make fast their drag-ropes, stretching them out to the rear on each side of the perch. 9 assists on the ropes.

The perch is slightly raised,† the Nos. fall back on the ends of the ropes; the bed rises to a vertical position, and the mortar falls on its muzzle. When the muzzle is coming to the ground the detachment must hold on well, to prevent the mortar overturning.

"Off wheels." Nos. 2, 4, 6 remove the right wheel, 3, 5, 7 the left; 8 and 9 remove linchpins and washers. The wheels are placed dish down, on their respective sides, two yards clear of the bed.

"Right the bed." The whole of the Nos. man the ropes, except 2 and 3, who apply their handspikes under the muzzle of the mortar, and at the word *"Heave"* from No. 1, the perch is hauled down and the bed rests on the ground.

Nos. 1 and 8 remove the drag-ropes, and the whole take post at the mortar.

TO LIMBER UP.

Officer.
Limber up.

No. 1.
Prepare to limber up.
Lift and heave.
On wheels.
Limber up.

"Prepare to limber up." 6 places two handspikes on the ground, about 6 inches in rear of the perch eye, as a fulcrum for the handspike of 2, who, assisted by 3, thus raises the bed

* This must be done with care or the perch may fly up.

† If the detachment is weak when the perch has been detached from the pintail, a drag-rope may be made fast to the perch eye, and the other end to the pintail of the limber, which should be run forward about four yards from the perch eye, then with drag-ropes on the drag-washers of the limber, manned by the detachment, the mortar can be lowered with ease on to the front of the bed; it may be limbered up in the same way, and indeed it will be found the best and easiest to follow this method both for unlimbering and for limbering up, unless spare numbers are available.

With the 13-inch especially, on account of its great weight, it is safest to do so. In this case, the drag-rope is made fast to the perch eye and axletree bed of the limber.

S.B. Ordnance (13-inch Mortar).

Section III.

high enough for 4 to place his handspike under it. This raises the perch sufficiently high for the bed to be lifted as follows:— 2 passes a handspike under the perch to 3, double-manned by 6 and 7 outside. 4 passes one behind them to 5, double-manned by 8 and 9, outside.

Nos. 1 and 8 each make fast a drag-rope to the perch eye, No. 1 passing his to the front, 8 to the rear. No. 1 hauls on the front drag-rope.

“Lift and heave.” The perch is raised; when the Nos. can no longer lift with effect, they drop off and man the ropes, at first in front, and as the muzzle comes to the ground in rear.

“On wheels.” The wheels are put on by the Nos. that took them off.

“Limber up.” 4 and 5 each place a handspike so as to scotch the wheels when they touch the ground.

The perch is then hauled down by the whole of the Nos. except 2, 3, 4 and 5, who assist with handspikes in front of the bed, placing their handspikes over the lower spokes of the wheels and under the bed and bearing down; 2, 3, 4, 5, 6, 7, steady the perch when horizontal, Nos. 1 and 8 cast off the drag-rope. 8 and 9 then bring up the limber; the perch is lowered on to the pintail, and No. 1 keys up.

The stores are replaced on the carriage by the Nos. that took them off.

The detachment then forms the order of march as with M.L. guns on travelling carriages.

13-INCH MORTAR (NINE NUMBERS).

TO UNLIMBER.

<u>Officer.</u>	<u>No. 1.</u>
<i>Unlimber.</i>	<i>Prepare to unlimber.</i>
	<i>Lift.</i>
	<i>Limber drive on.</i>
	<i>Lower.</i>
	<i>Off wheels.</i>
	<i>Right the bed.</i>
	<i>Heave.</i>
	<i>Take post.</i>

The operation is conducted in the same way as with the 10-inch, but requires two detachments. The best mode of procedure is that described in the footnote* under the head of “To Unlimber” the 10-inch.

Section III

S.B. Ordnance (13-inch Mortar).

TO LIMBER UP.

<i>Officer.</i>	<i>No. 1.</i>
<i>Limber up.</i>	<i>Prepare to limber up.</i>
	<i>Lift.</i>
	<i>Lower.</i>
	<i>Fresh purchase.</i> } <i>repeated</i>
	<i>Lift.</i> } <i>if</i>
	<i>Lower.</i> } <i>necessary.</i>
	<i>Prepare to place the jack.</i>
	<i>Lift.</i>
	<i>Lower.</i>
	<i>Fix drag-ropes.</i>
	<i>Cross handspikes.</i>
	<i>Lift and heave.</i>
	<i>On wheels.</i>

"*Prepare to limber up.*" 2, 3, 4, 5, apply their handspikes crosswise, under the perch, doubled manned by the same numbers of the second detachment, and by 8 and 9 of both detachments; 6 and 7 of both detachments bring up and attend to the jack and skidding respectively.

"*Lift.*" The bed is raised, and a 6' x 9' skid on its flat placed under it, on each side as far to the front as practicable.

"*Lower.*" The bed is lowered on to the skidding.

"*Fresh purchase.*" The same numbers apply their handspikes under the bed. "*Lift.*" The bed is raised and the "6 x 9" turned on their edge and worked to the front; this is to be repeated until the bed is skidded close up to the axletree arms.

"*Lower.*" The bed is allowed to rest on the skidding.

"*Prepare to place the jack.*" One handspike is applied horizontally under the rear horns, manned by 2 and 3 of both detachments; the other under the bolt of the dragshoe chain on the perch, manned by 4 and 5 of both detachments. The two numbers 7 apply a handspike on each side under the bed, the points resting on an oak plank, double manned by 8 and 9 of both detachments.

"*Lift.*" The bed is raised, one No. 6 places a plank, the other the jack on it under the centre of the bed, and as far to the front as possible.

"*Lower.*" The bed is lowered on to the jack, which is then worked up to its full extent.

"*Fix drag-ropes.*" 8 and 9 each hook a drag-rope to the perch eye, and pass the ends to the front, 8 of the second detachment hooks a drag-rope to the perch eye and passes the end to the rear. 6 and 7 place a handspike vertically on each side of the mortar, between it and the sides of the bed, and make a clove hitch on the drag-rope round the small ends; the ends leading to the front are twisted together, and manned by all the Nos.,

S.B. Ordnance (13-inch Mortar).Section III.

except 2, 3, 4, 5, of both detachments; who at "*Cross handspikes*" apply handspikes under the rear horns and perch as before described.

"*Lift and heave.*" The bed is brought vertical, the handspike Nos. when they can no longer lift, falling back to the end of the rear drag-rope, two at a time, and holding on to prevent the mortar falling over to the front. "*On wheels.*" The wheels are put on by the same Nos. that took them off.

"*Limber up.*" 4 and 5 each place a handspike so as to scotch the wheels when they touch the ground.

The perch is then hauled down by the whole of the Nos., except 2, 3, 4, 5, 6, 7, who assist with handspikes at the sides and in front of the bed, the remaining Nos. and the second detachment hauling on the ropes. 2, 3, 4, 5, 6, 7, steady the perch when horizontal, Nos. 1 and 8 cast off drag-ropes. 8 and 9 then bring up the limber, and the perch eye is lowered on to the pin-tail, when No. 1 keys up the keep chain, and 2 and 3 the draught chain.

The stores are replaced on the carriage by the Nos. that took them off, and the detachment forms the order of march.

Section IV.

Instructions in Laying Ordnance.

Section IV.—Instruction in Laying Ordnance for
Garrison Service.

EXPLANATION OF TERMS.

Before proceeding to instruct in laying, it will be necessary to explain everything connected with the sights and scales, also certain terms, such as, axis of the gun, axis of the trunnions, line of fire, line of sight, trajectory, range, elevation, depression, drift and lateral deviation, velocity, &c.

Should it be necessary to make use of such terms as parallel, right angles, horizontal, vertical, &c., they also must be explained.

The definitions in gunnery will be found pages 3 and 4.

FITTING OF SIGHTS AND MARKS ON HIND SIGHTS.

The manner in which the sights are fitted to the gun should then be pointed out, and the marks on the sides of the bar of the hind sights and deflection leaves explained.

TO ADJUST THE SCALE FOR ELEVATION.

The hind sight is raised until the mark for the required number of yards is in line with the top of the socket in which the scale slides, and clamped.

TO ADJUST THE SCALE FOR DEFLECTION.

Deflection is given to the right or left of the zero point until the arrow points to the required number of minutes. The scale is then clamped. Deflection is always given on that side to which the shot is to be thrown.

As a practical rule each minute of deflection on the sight gives a difference of an inch in every 100 yards of range; thus, supposing that at a range of 2,400 yards a projectile has struck 12 feet to the right of the object, it will be necessary to move the leaf 6 minutes to the left or give "six minutes' left deflection" to correct the error, because 12 feet or 144 inches divided by 24 (the number of hundreds of yards in the range) gives 6.

Instructions in Laying Ordnance.

Section IV.

TO LAY A GUN.

To lay a gun is to direct it in such a manner that the top of the notch of the hind sight, the apex of the foresight, and the object are in line. This is termed laying with a "Full" sight.

The top of the notch of the hind sight is an imaginary point midway between the two highest points on the sight.

The scales having been adjusted as explained, No. 1 proceeds to lay the gun.

He places himself, bringing his eye on a level with the top of the hind sight, and at least one foot from it. (The larger the notch in the tangent scale the further should the eye be from it).

When laying guns where it is necessary to stoop, he places his feet so that the body is well balanced, steadying himself by leaning on the gun with his arm; and giving the necessary orders for elevating or traversing until the gun is laid as above.

GENERAL RULES TO BE OBSERVED.

In laying a gun avoid putting the back of the nail on the top of the sight, holding the tangent scale, covering the eye with the hand or other peculiarity.

Always lay as quickly as possible, as the eye will then not become wearied. Lay over the object in every case in the first instance, and depress on to it, thereby obviating error due to the play of the elevating screw or arc.

When the emplacement is fitted with a graduated arc and the traversing platform with a pointer, the requisite angle of training having been ascertained, the gun can be laid by that means. With the 38-ton gun having the degrees of elevation marked on the elevating arc, this mode of giving elevation should be used when requisite; but it must be remembered that this is quadrant elevation.

Much will depend on the Nos. who move the gun under direction of No. 1. With practice and intelligence they will readily understand when the gun is to be moved fast or slow, much or little; the word of command will be a guide to them.

When comparatively loud they will work fast, when low they will understand that the gun is nearly on the object, and must be moved gently.

SPECIAL RULES. FIXED OBJECTS.

In firing at a target always lay on the most conspicuous part of it; this will usually be one of the edges or corners. The gun should always, when possible, be laid on the target itself and not on an imaginary point right or left of it, above or below it, all allowances for wind being made on the deflection scale and corrections in elevation on the elevating scale.

Section IV.

Instructions in Laying Ordnance.

The wind has considerable effect in causing the shot to deviate to the right or left, and in increasing or reducing the range, especially at long ranges; by observing its strength and direction before commencing practice, allowance can be approximately made for it at the first round.

The men should be practised whenever practicable in laying at such objects as troops (cavalry, artillery, and infantry) standing and in motion; houses, hedges, enclosures, batteries, entrenchments, &c., &c., as these are the targets likely to be met with on service.

MOVING OBJECTS.

No man ought to be allowed to fire at a moving object unless he has shown an aptitude for laying guns at a standing mark. For beginners it will be convenient to move the object across the range in such a manner that the elevation may remain nearly the same; with skilled men the object can move obliquely across the range. In firing at a moving object four cases may occur, viz.

1. The object moving directly on the battery.
2. The object moving directly away from the battery.
3. The object moving across the front of the battery.
4. The object moving obliquely to the front of the battery.

Cases 1 and 2 speak for themselves; in cases 3 and 4, if the object is a vessel, the gun would be laid on the bows; if troops in column, on the head of the column.

In firing at a moving target ($6' \times 6'$) in case 3, if the rate at which it is moving and the range are known (the latter either by use of range finders as the target moves, or by ascertaining previously the range from the battery to certain points it is likely to pass) either of the following plans can be adopted:—(a) the gun can be traversed sufficiently in front to allow of its being fired deliberately when the target arrives at the distance for which allowance has to be made; or (b) the allowance can be made on the deflection scale, and the gun fired as the target crosses the line of sight. Taking for example fire from a 9-inch gun with battering charge at a target moving at the rate of 7 miles an hour, and the range to the object it will pass 1,270 yards. The time of flight of the projectile at that range being 3 seconds, and the target moving 10 yards in that time, in case (a) by firing the gun when laid 11 yards in front of the target, the projectile should strike near its centre; in case (b) more time is afforded for deliberate firing, deflection being given according to the range and rate at which the target is moving. In the above instance 10 yards, or 360 inches divided by 12.7 hundreds of yards of range, equals 28 minutes' deflection to give on the side towards which the target is moving, and the gun should be fired as the target crosses the line of sight at the known range.

Instructions in Laying Ordnance.

Section IV.

The above example is given with a view to drawing attention to the general principles involved in firing at a moving object. In practice the following rule will be a sufficient guide, not taking into account the direction of the wind.

Multiply the rate per hour the target is moving across the range by 5 for the number of minutes' deflection to give at any range on the side towards which it is moving.

If firing at a moving object from guns on travelling carriages, it must be remembered that even on ordinarily level ground moving the trail may affect the elevation. When firing at a moving object, No. 1, as soon as he has adjusted his scale, must place himself in prolongation of the line of sight, stepping clear of the recoil as he gives the order "*Fire.*" With guns on traversing platforms he jumps down from the platform, giving the word "*Fire.*"

It is found in practice that the principal errors are those of elevation, arising from the fact that on laying ahead the gun is not truly on the line in which the object is moving. Errors in direction are principally due to variations caused by wind, the force of which should always be taken into consideration. It should be remembered that when firing at an object moving in the direction towards which the wind is blowing, less deflection is necessary than would be given by the rule above-mentioned, and more if the wind is blowing in the opposite direction.

LAYING MORTARS.

Ranges of mortars are regulated by the charge.

Mortars are marked with a notch on the muzzle ring and one behind the vent. If the platform is perfectly horizontal the line joining these notches will mark the position of the axis of the mortar. If the platform is not horizontal, a line corresponding with the axis of the mortar, along the highest surface of it, must be found by means of the perpendicular. In either case the line should be marked in chalk.

A mortar is correctly laid on an object when the axis of the mortar and the object are in the same vertical plane.

To lay a Mortar.

There are two cases which may arise in laying a mortar :—

1st. When the object can be seen from the rear of the mortar.

2nd. When the object cannot be seen from the mortar or from any convenient point behind it.

In the first case the mortar is laid on the object; in the other case upon two pickets called pointing rods, which are placed in front of the mortar in the vertical plane passing through the centre of the platform and the object.

Section IV.

Instructions in Laying Ordnance.

In the second case No. 3 places the pointing rods on the parapet between the object and centre of the platform; No. 1 standing in the rear of the centre of the platform sees whether he can lay the mortar on the pointing rods and at the same time keep it near the centre of the platform, if not he directs 3 to lay the pointing rods again on the object, but to the right or left of their former position as may be required; when they are satisfactorily placed, No. 1 sees that they are correctly in line with the object.

The pointing rods must be perfectly upright, the front should be placed first.

No. 1 has now to move the mortar until the chalk line is in line with the two pointing rods. Holding the plummet line with his right hand, a little distance above and in front of his right eye, he places himself in the rear of the platform so as to cover the pointing rods. He must then cause the mortar to be moved till the line marking the axis of the mortar coincides with the line which passes through the two pointing rods and the plummet line.

NIGHT FIRING.

The following expedients may be resorted to to insure accuracy of fire at night:—

40-PR. B.L. ON TRAVELLING CARRIAGE.

The gun having been properly laid during the day, the elevation is taken by quadrant or clinometer, and a batten nailed to the platform, inside each wheel, parallel to the line of fire, two short pieces being nailed in like manner on either side of the trail.

GUNS ON STANDING CARRIAGES.

With a gun mounted on a standing carriage a long batten should be used, against which the trucks on one side of the carriage should bear.

It may also facilitate the laying of a gun at night, if corresponding points on the carriage and platform are marked with chalk, also the trunnions, coils, elevating screw, and carriage, after the gun has been laid by day. The apex of the foresight should also be made as definite as possible.

At night the carriage is brought into the same position by means of the battens, and the elevation, which had been previously ascertained by day, given by quadrant or clinometer, or by the marks previously made.

Lanterns must be used for the service of the guns at night.

Instructions in Laying Ordnance.

Section IV.**GUNS ON TRAVERSING PLATFORMS.**

With wooden traversing platforms the racers would be marked; with iron ones fitted with pointers and graduated arcs on the ground platforms, these would be utilised.

TO JUDGE DISTANCES.

As it is evident that the distance should be known in order to determine the required elevation and length of fuze, too much pains cannot be taken in instructing men to ascertain distances correctly.

In all positions there are many objects, the ranges of which are known, men may therefore be constantly exercised in judging distances.

Range finders will be generally introduced into the service; they should not be allowed to serve as an excuse for not teaching men to be quick at judging distances, but should rather assist the instruction. Cases may arise where minutes may be of immense importance, and a readily guessed range of great use. Accident might also disarrange the instruments, and without knowledge much time and ammunition be wasted.

Ground is most deceptive, and the apparent distance varies with light, &c., and very little can in reality be ascertained by a trial shot.

TO OBTAIN THE LINE OF FIRE FROM GUNS MOUNTED ON LAND FRONTS, THE OBJECT BEING INVISIBLE FROM THE BATTERY.

This is explained under the head of "Siege Artillery," page 120.

HYDRO-CLINOMETER FOR ASCERTAINING RANGES FROM ELEVATED COAST BATTERIES.**INSTRUCTIONS FOR USING THE HYDRO-CLINOMETER.****CAUTION.**

1. Do not attempt to remove any of the screws, &c.
2. Do not remove the glasses of the telescope, but simply wipe off the dust with a soft pocket handkerchief.
3. Do not attempt to clean the brass work with brick-dust or oil; simply wipe with a soft rag.

Section IV.

Instructions in Laying Ordnance.

OPERATION.

1. On removing the instrument from the box, hold it in a vertical position until the fluid has all drained out of the tube into the reservoir, slightly shaking to stir up the colouring matter.

2. Raise the brass arm vertical.

3. Place the reservoir end of the instrument (the end with brass plate) into the groove in front part of the box.

4. Place the screw found on the reverse side of the instrument into the slot of the brass arm, drop on the spring washer and clamp by means of the thumb screw.

5. Remove the cap of the telescope, and draw out the eye piece gradually, until the cross wires are distinctly visible.

6. Push out the object glass by means of the little brass handle on the right front of the telescope, until any distant object is brought into sharp focus.

The instrument is now ready for use, either with a range scale adapted to the battery, or by means of the angle of depression scale in conjunction with the calculating scale.

1st, *With a range scale.*—Place the box on any moderately level place, on the parapet, or in two shot boxes placed across the side pieces of a traversing platform, and direct the telescope in line with the object by moving the case in the required direction; now hold the small end of the instrument in the *left* hand, and unscrew the thumb screw with the *right*; raise or lower the left hand, as the case may be, until the intersection of the cross hairs of the telescope are slightly *below* the object, and clamp with the thumb screw. By drawing the brass arm towards the observer, a slow motion will be given to the telescope, and the intersection of the cross wires brought exactly on to the water line of the object.

The position of the upper part of the fluid will indicate the range.

2nd. *Using the depression scale in conjunction with the calculating scales.*

Proceed as before to lay the telescope, when the upper part of the fluid will indicate the angle of depression in degrees and minutes.

The calculating scale has three rows of figures engraved upon it:—

The upper representing height of battery in feet.

The centre representing angles of depression.

The lower representing range in yards.

The centre scale is moveable, and has engraved at one end an \uparrow . To find the range, slide out the centre scale, until the line representing the depression is opposite the line representing the height of the battery. The number of yards on the lower scale opposite the \uparrow will be the range or distance from the instrument to the object.

Instructions in Laying Ordnance.

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Thus suppose for example :—

The angle of depression	2° 30'
Height of battery	130 feet

Slide centre scale out until the line 2° 30' is opposite the line 130 on upper scale. The number of yards opposite the arrow is 1,000, which is the required range.

TO MAKE A SCALE FOR ANY BATTERY.

Draw cut the centre scale until the arrow is successively opposite the numbers 500, 600, &c., &c., and note the corresponding angles of depression on the centre scale opposite the height of the battery.

Place a plain strip of wood exactly over the one in the instrument engraved with angles of depression; mark the angles noted, and complete scale in the usual manner.

Thus suppose the height 130 feet :—

The angle opposite 130 feet..	500 yards =	4° 57'
When the arrow is at ..	600 „	= 4° 10'
„ „ ..	700 „	= 3° 32'

Now place the plain slip of wood exactly over the depression scale, and make marks at 4° 57', 4° 10', 3° 32', &c., &c.

Complete the scale, lettering these respective marks, 500, 600, 700 yards, &c., &c.

Should it be necessary at any time to remove the glasses from the telescope, the angle of depression of some well defined object about 2,000 yards distant should be noted.

When the lenses have been replaced, test to see if the same angle is read off.

Any slight error (arising probably from not screwing up the object glass) may be corrected by turning the capstan headed screws on the body of the telescope in the same manner as for a theodolite.

It would be as well, on the receipt of an instrument at a station, to take a memorandum of the angle of depression of some fixed object, so that in the event of any accident happening it may be easily readjusted.

Material and Appliances.

PART V.—MATERIAL AND APPLIANCES.*

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CORDAGE.

A certain proportion of fibres of hemp twisted together form a yarn, and a number of yarns form a strand. Three strands twisted together form a rope. The size of the rope depends upon the number of yarns contained in it. The circumference of a rope expressed in inches denotes its size.

Rope is issued either white or tarred, the latter being most serviceable when liable to be exposed to wet, the former when not so exposed. Rope is known as hawser, shroud-laid or cable-laid. That made in H.M.'s Dockyards is distinguished by a coloured thread running through each strand.

A hawser consists of three strands, and is laid up right-handed, or what is termed "with the sun." Fig. 1.

* Not including gyny, crab capstans, iron crabs, jacks, sling wagons, sling cart, platform wagon, trench cart, and hand cart, for which see Part VII., page 463.

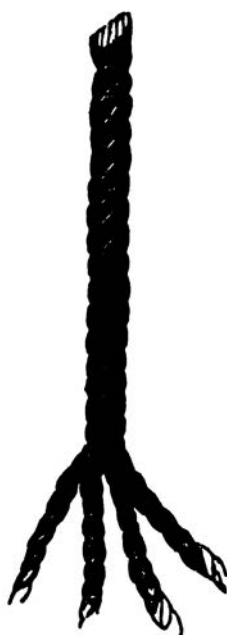
Material and Appliances.

Fig. 1.



Shroud-laid rope consists of four strands, laid up "with the sun." Fig. 2.

Fig. 2.



(A. M.)

Z

Material and Appliances.

Cable-laid rope is nine-stranded, laid up "against the sun."
Fig. 3.

Fig. 3.



TABLE OF CORDAGE.

The following Table shows the different natures of cordage most commonly used in the Artillery Service :—

TABLE OF HAWSERLAID CORDAGE, WHITE OR TARRED.

Circumference in Inches.			Safe Working Load.		Use.
			New.	Worn.	
White (only)	12	..	Tons. 20½	Tons. 18	Slings for heavy guns, &c.
White or tarred,	9	..	11½	10½	"
"	7½	..	8	7	Falls for heavy sheer tackles.
"	7	..	7	6½	" " "
"	6½	..	6	5½	" " "
"	6	..	5½	4½	" " and heavy parbuckle ropes.
"	5	..	3½	3½	Falls for heavy gyn tackles, &c.
"	4½	..	2½	2½	Guys and parbuckle ropes.
"	4	..	2½	2	Falls for light gyn tackles, &c.
"	3½	..	1½	1½	Head lashings for sheers, &c.
"	3	..	1½	1½	Heavy drag ropes, &c.
"	2½	..	¾	¾	Falls for luff tackles, lashings, &c.
"	2	..	¾	¾	Lashings, &c.
"	1½	..	¾	¾	Light lashings, &c.
"	1	..	¾	¾	" "

Material and Appliances.

TABLE OF ROPES.

A list of Service Tackles is given at page 403, and of Service Slings at page 487.

Description.	Size.	Length.	Remarks.
Ropes, Drag, heavy	3 in. ..	5 fms. ..	White.
" Preventor	3½ in..	30 to 40 ft. ..	White.
" Parbuckling	4½ in..	12, 15, and 18 fms. ..	Tarred.
" "	6 in. ..	18 fms. ..	White.
" *Gasket ..	3½ in..	2½ fms. ..	Tarred (Crab-capstan).
" "	3½ in..	—	White (Gibraltar gyn).
" "	6 in. ..	3 fms. ..	White (Iron Crab).
" Lashing ..	2½ in..	5 fms. ..	Tarred.
" "	1½ in..	3 fms. ..	White.

There are also three smaller descriptions of cordage, viz., *marline*, *hambro' line*, and *spun yarn*.

Marline consists of two twisted yarns of fine hemp twisted together.

Hambro' line is composed of four slightly twisted yarns of coarse hemp twisted together, forming three strands, which are also twisted together.

Spun yarn consists of four slightly twisted yarns of coarse tarred hemp twisted together.

New rope is made up in coils of about 113 fathoms each.

Marline and hambro' line in skeins, and spun yarn in lbs.

Rope is coiled from left to right, or "with the sun."

Coils of rope should be uncoiled and stretched in the manner described at page 428: the time occupied in so doing will be more than repaid in subsequent operations by the freedom from twist of ropes that have been so treated. Small ropes may be stretched by hand; one end being made fast, the other is hauled on, and the rope allowed to turn in the hands. Rope when wet shrinks, and rope thoroughly saturated is less strong than the same rope dry. Ropes of Italian or Russian hemp may lose one-third of their strength if soaked for, say, 72 hours.

A practical rule for finding the weight of a rope is to multiply the square of the circumference in inches by the length in fathoms, and divide by 480 for the weight in hundredweights.

A rough rule for calculating the working strain of a new rope, is to square the circumference, and divide by seven for the strain in tons; with rope much worn it would be advisable to divide it by eight.

* Gaskets may be made of any sized rope, and should be not less in strength than the rope they are intended to stopper.

(A. M.)

Material and Appliances.

No reliance should be placed on rope which is "stranded," that is, one strand being made to bear the whole weight from unequal stretching. A "stranded" rope presents an unusually uneven surface.

In hauling on ropes, the men should plant their feet firmly on the ground, and haul together. Easing off should invariably be done gradually, hand over hand, that is, the rope should not be allowed to slip through the hand.

WIRE ROPE.

Wire ropes are frequently used for the guys of sheers; the following table gives the working load and breaking strain of some natures most commonly met with.

TABLE OF ROUND ROPES OF IRON AND STEEL WIRE.

Iron Wire.				Steel Wire.			
Circumference in Inches.	lbs. Weight per Fathom.	Working Load.	Breaking Strain.	Circumference in Inches.	lbs. Weight per Fathom.	Working Load.	Breaking Strain.
		cwts.	Tons.			cwts.	Tons.
2	3½	21	7	2	3½	36	12
2½	5½	33	11	2½	5½	54	18
3	7½	45	15	3½	8	78	26
3½	10	60	20	3½	10	108	36
4	14	84	28	3½	12	120	40
4½	18	108	36				
4½	20	120	40				

WHIPPING.

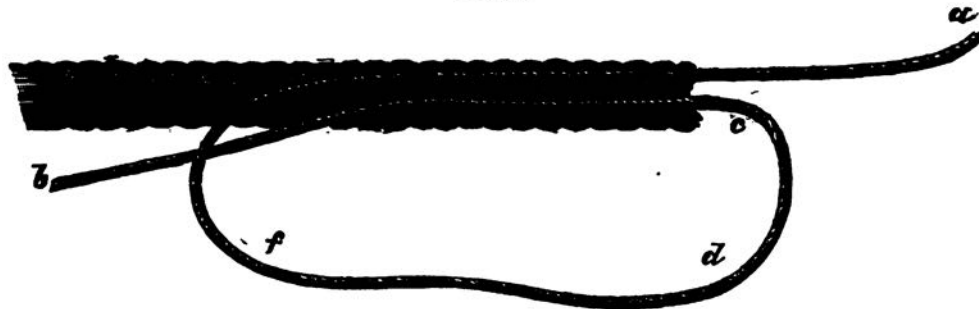
To Whip a Rope

is to tie a piece of twine round the end to prevent it from un-twisting and unfraying.

Take a piece of twine about 2 or 3 feet long, according to the size of the rope, and place it as in Fig. 4, one end *a* lying to the right, the other *b* along the rope to the left.

Material and Appliances.

Fig. 4.



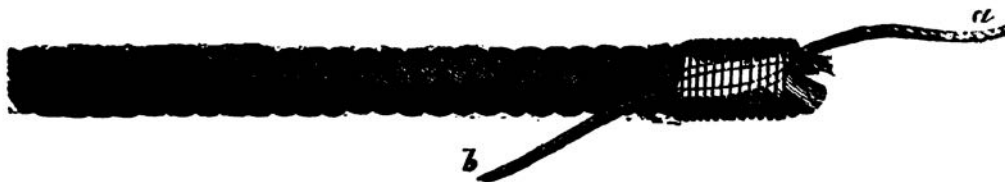
Wind the part *c d f* tightly round the end of the rope, and the two ends of the whipping twine *a* and *b*, the requisite number of times. Fig. 5.

Fig. 5.



Then, by heaving on the ends of the twine *a* and *b* the whipping is tautened up and completed. Fig. 6.

Fig. 6.



SEIZING.

To Seize a Rope

is to connect two parts together with lashing.

Take a piece of spun yarn, and double it; pass the bight from right to left under both parts of the rope to be seized, then pass the ends of the yarn through the bight, and haul taut. Separate the ends, and pass them round in contrary directions, making fast with a reef knot after as many turns have been taken as is necessary. Figs. 7 and 8.

Material and Appliances.

Fig. 7.

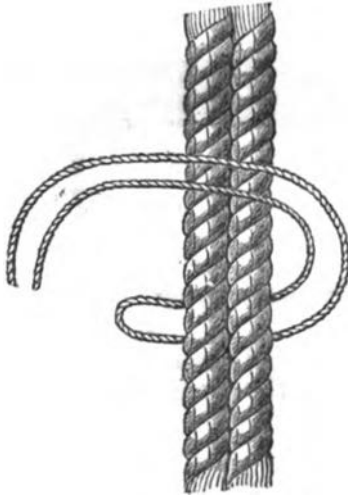
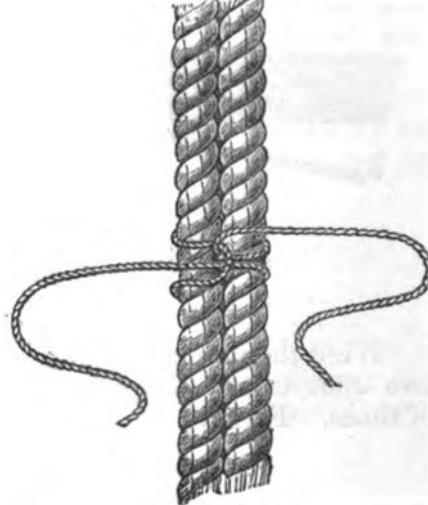


Fig. 8.

**MOUSING A HOOK**

is to seize the point and back of the hook, in order to prevent its disengaging itself from anything to which it may be hooked; the returns of the spun yarn are brought together close to the inside of the point of the hook, by two or three turns being taken with the ends in opposite directions round all the returns and secured by a reef knot. Fig. 9.

The hooks of all blocks, on which a variable strain is brought, or which have not frequently to be shifted, should be moused.

Fig. 9.

**POINTING.**

To point a rope is to taper the ends so that they can more easily enter a hole or block.

The end is unlaid or untwisted, and some of the centre yarns cut out; the outside yarns are then wove so as to form a casing about the diminished part, and the point whipped so as to prevent it from being untwisted. This is performed in the following manner:—

Pass a temporary seizing round the part of the rope at which it is intended the pointing should commence, Fig. 10, then untwist the strands as far as this part, and separate all the yarns; from the inside part of the rope take out as many yarns as are necessary, cutting or scraping them off gradually to a point, so that they appear as in Fig. 11. The remaining or outside yarns, 12 per

Material and Appliances.

inch of rope's circumference, are then to be untwisted, and nettles made, which is done by dividing each yarn into two and twisting them up, Fig. 12. Then lay one half of the nettles, 1, 1, 1, 1, down upon the scraped part of the rope, and the other half, 2, 2, 2, 2, back upon the rope, Fig. 13. Next take a length of waxed twine, and pass three turns of it very taut round between the nettles, jamming them with a hitch, so as to bind nettles 1, 1, 1, 1, to the scraped part of the rope, and leave the nettles 2, 2, 2, 2, free, Fig. 13. Then lay the nettles 1, 1, 1, backward on the rope, and 2, 2, 2, forward on the scraped part, and pass the twine as before, binding the nettles 2, 2, 2, and leaving 1, 1, 1, free Fig. 14; then lay 2, 2, 2, back on the rope, and bring 1, 1, 1, forward, and proceed as before detailed. The ends may be whipped with twine, or the nettles hitched over the warp and hauled taut; and the rope, when properly pointed and finished, will appear as at Fig. 15.

Fig. 10.



Fig. 11.

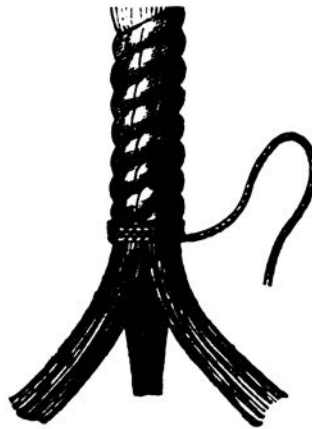


Fig. 12.

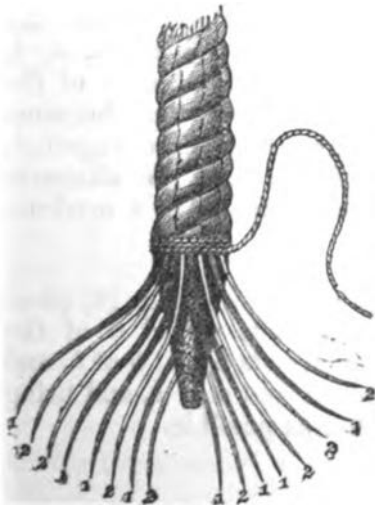
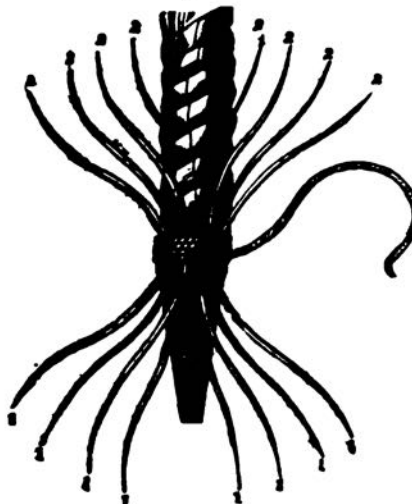


Fig. 13.



Material and Appliances.

Fig. 14.

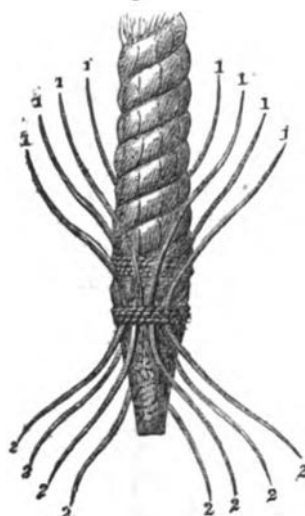


Fig. 15.



SPLICING.

To splice a rope is to join the two ends together, or to unite the end to any part thereof, by interweaving the strands in a regular manner.

Short Splice.—This splice is used in cables, slings, block straps, and all ropes which are *not* intended to run through blocks. To make it, it is necessary to untwist the ends of two ropes, *a*, *b*, Fig. 16, for a convenient length; and having placed each of the strands of one (1, 2, 3) opposite to and in the interval between the strands of the other (4, 5, 6), to draw them close together, and then to interweave the strands of one into the alternate strands of the other, by penetrating the latter with a marline-spike or other pointed instrument.

Having untwisted the ends of two ropes, *a*, *b*, Fig. 16, place the strand 1 of the rope *a* between the strands 4 and 6 of the rope *b*, the strand 2 of *a* between the strands 6 and 5 of *b*, and the strand 3 of *a* between the strands 5 and 4 of *b*, and bring the strands of both ropes as close together as possible.

 Material and Appliances.

Fig. 16.



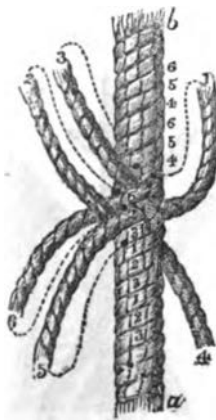
Fig. 17.



Then take the opened strand 1, pass it over the strand 4 of the twisted part of *b*, and by means of a marlinespike raise the strand 5 of the same twisted part of *b*, and pass the end of 1 through it, and haul close up. Fig. 17.

The strand 3 is then to be passed over the strand 5, and by means of a marlinespike passed under the strand 6 of the twisted part of *b*, and hauled close up. Fig. 18.

Fig. 18.



Lastly, the strand 2 is to be passed over the strand 6, and under the strand 4 of the twisted part of *b*. Fig. 19.

Material and Appliances.

Fig. 19.



The two ends of the ropes are then to be hauled in contrary directions, strand by strand, in order to make the first part of the operation of splicing as firm as possible.

The strands 4, 5, and 6 of the rope *b* are then to be worked into the strands 1, 2, and 3 of the rope *a*, in the same manner as already described—viz., the strand 4 to be passed over 1 and under 2; the strand 6 over 2 and under 3; and the strand 5 over 3 and under 1; the whole of the strands being hauled through to make the splice as tight as possible.

The ends 1, 2, and 3 are then to be passed a second time through the strands 4, 5, and 6 of *b*. The strands will now have been thrice interwoven with each other; with ordinary ropes twice is found sufficient; should it, however, be wished to make the splice more secure, the operation may be continued as far as may be judged necessary. Fig. 20.

Fig. 20.



Material and Appliances.

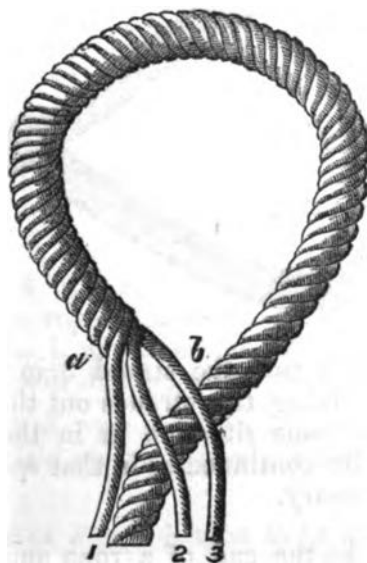
The strands are always to be hauled well through, and beaten with the marlinespike or a mallet, that the splice may be firm and not draw, and when completed the ends of the strands cut off close to the rope.

In large ropes, such as gun slings, much more of the rope, in proportion to the splice, must be unstranded than in smaller ropes, from the difficulty of hauling the strands sufficiently taut by hand.

Eye Splice.—The eyesplice forms a sort of eye or circle on a rope, and is also used for splicing in thimbles. It is made on the same principle as the short splice. The strands are untwisted as far as may be judged necessary, and their ends thrust through the three strands in that part of the rope whereon the splice is to be formed; and passing over the second strand, they are thrust through the third, and so on until the splice is completed to the length required, Fig. 23.

The part *a* of the rope which has been untwisted is to be laid on the part *b* of the twisted rope where the splice is to come, Fig. 21; the strand 2 of the untwisted part *a* is then to be passed to the right under the strand 4 of the twisted part *b*, Fig. 22; the strand 1 of *a* to be also passed to the right over 4 and under 5 of *b*. The strand 3, however, is to be passed to the left over 6, and then to the right, but under the same strand 6 of *b*; all the strands to be hauled taut.

Fig. 21.



Material and Appliances.

Fig. 22.

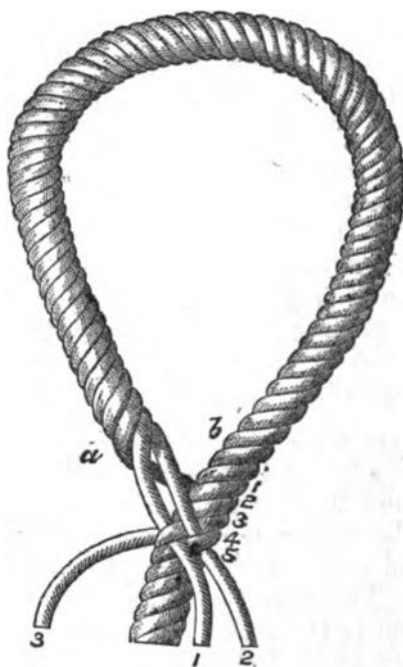
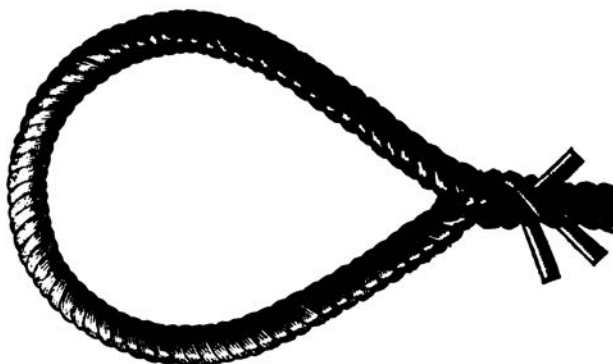


Fig. 23.



It was necessary to pass the strand 3 in the manner above described, in order to bring the strands out the same way, which brings them into the same situation as in the short splice; the operation is then to be continued as in that splice, and for such a length as may be necessary.

Flemish Eye.—Take the end of a rope and unlay one strand, Fig. 24; form the eye, Fig. 25; filling up the intervals with the strand *a* until it returns and lies under the eye. The ends are then scraped down, tapered, and served with spun yarn.

 Material and Appliances.

Fig. 24.



Fig. 25.



Long Splice.—A long splice is made to join ropes intended to run through a block. It occupies a greater extent of the rope than the short splice, but, by the three joinings being fixed at a greater distance from each other, the increase of bulk is divided; hence it is much neater and smoother than the short splice. One end of each rope is opened to a convenient length, and placed close together regularly, one strand between the other, as in the short splice. Fig. 26.

One strand, No. 4, of *b* rope is then unlaid, and the opposite strand, No. 1, of the rope *a* laid up its interval, continuing to unlaid No. 4 as No. 1 advances, and as far as may be judged necessary; the rope will then appear as Fig. 27.

The strand No. 2 of rope *a* is then to be unlaid, and the strand No. 5 of the rope *b* laid up its interval, in the same manner as the former. Fig. 28.

The strand No. 6 of *b* rope is then to be unlaid, and the strand No. 3 of the rope *a* laid up its interval, but only half as far up as the part where 1 and 4 meet: after these three operations the rope will appear as in Fig. 29.

Material and Appliances.

Each two strands which are opposite to each other, viz., 1 and 4, 2 and 5, 3 and 6, are to be knotted together at their ends, or where they meet, by an overhand knot, Figs. 30, 31; the ends are then to be tapered and pushed under the next strand, Figs. 32, 33, and hauled through; they are then cut off, Fig. 34. The place where the overhand knot is made must be beaten with a mallet or marlinespike.

Fig. 26.



Fig. 27.



 Material and Appliances.

Fig. 28.

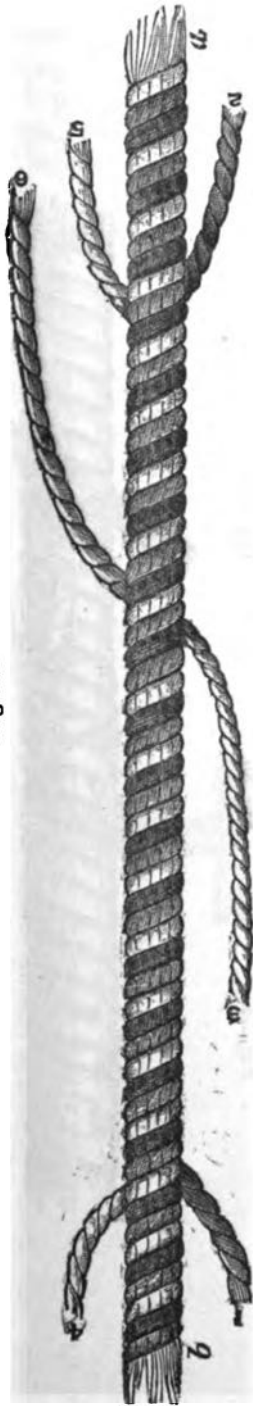
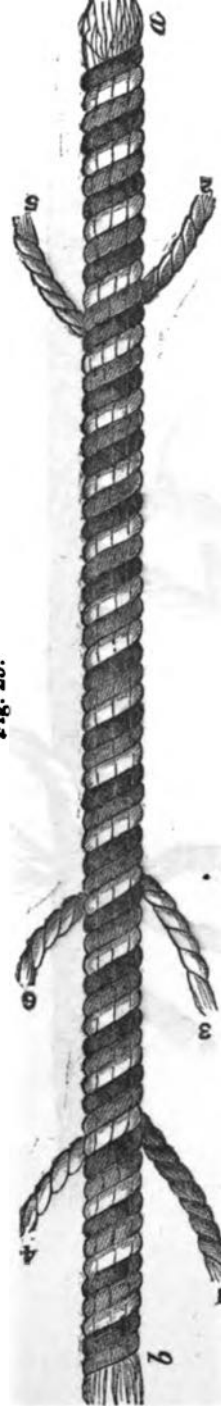
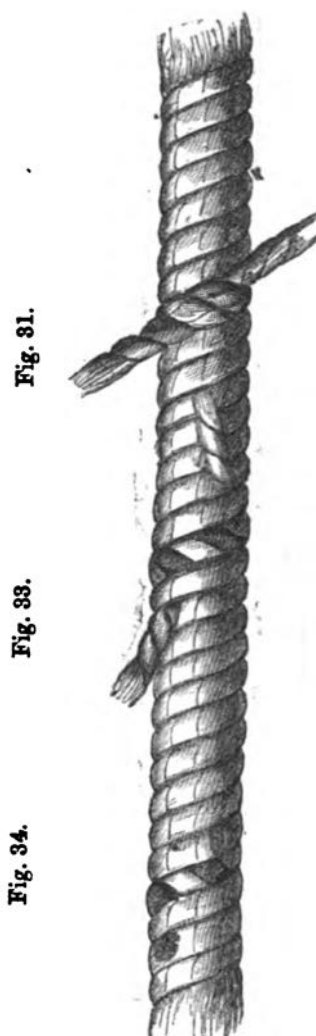
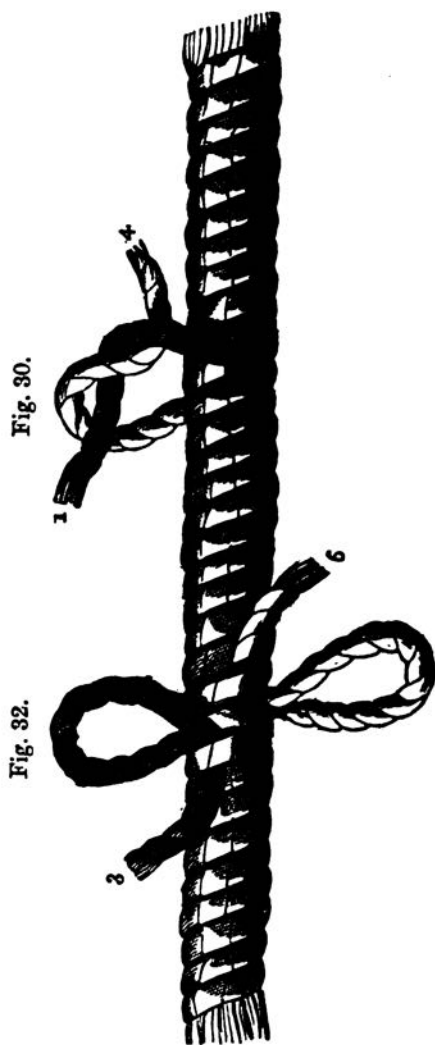


Fig. 29.



Material and Appliances.



Material and Appliances.

SERVING.

To serve a rope is to wind line or small rope round it by means of a serving mallet, to prevent it from being chafed.

The rope is stretched taut, and the line being wound up into a ball, two or more turns are taken from it round the rope. The serving mallet is then placed on the rope, and two or more returns are passed round the rope and mallet and round the handle; the mallet is then turned, while another person passes the ball round the rope, which leaves the yarn on the rope, and draws it tight, Fig. 35.

Fig. 35.



(A. M.)

2 A

Material and Appliances.

PARCELLING.

To parcel a rope is to put round it canvas, well daubed with tar and bound with spun yarn, to protect it from chafing.

KNOTTING.

The following are the knots generally used; some are sufficiently explained by the diagrams alone, others are described in detail:—

Thumb or Overhand Knot.—Fig. 36.

Fig. 36.



Use.—To prevent the running end of a fall passing through the sheaves of a block, &c.

Figure-of-eight Knot.—Fig. 37.

Fig. 37.



Use.—Same as Thumb Knot, Fig. 36.

Reef Knot, Figs. 38, 39.

Fig. 38.



Fig. 39.



Use.—Joining two ends of rope or chain together.

Material and Appliances.

Draw Knot.—Figs. 40, 41.

Fig. 40.

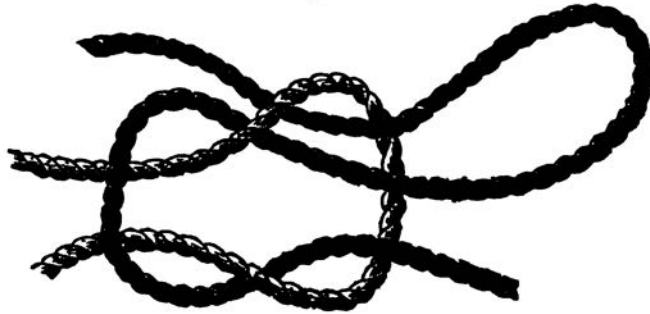
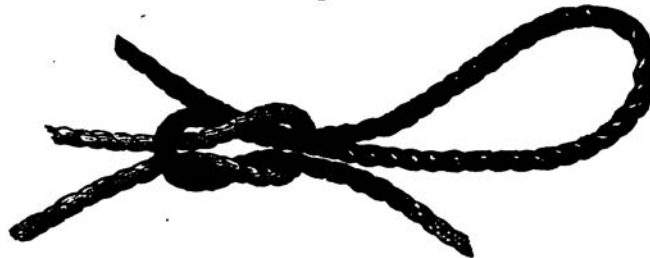


Fig. 41.



Use.—Joining two ends of rope together, when it may be required to cast them loose at once.

Running Knot.—Figs. 42, 43.

Fig. 42.



Fig. 43.



Use.—To form a loop that will draw taut round an object.

Single Bowline Knot.—Take the end of the rope in the right hand, back up, the end towards the left; then lay hold of the rope with the left hand, back down, about 4 feet from the end, forming a bight in the rope towards the body; lay the end of the rope in the right hand, in front of and over the portion of rope in the left hand: with the forefinger and thumb of the right hand lay hold of both returns of the rope, and by a turn of the right wrist

(A. M.)

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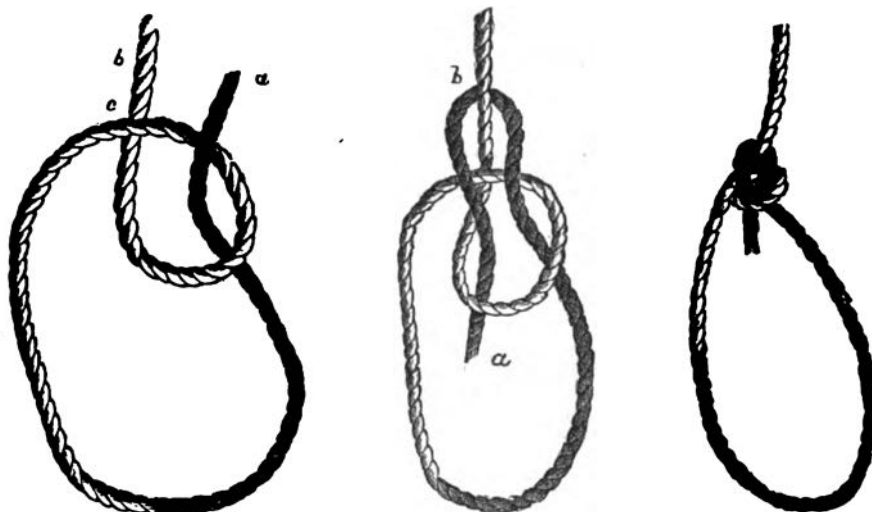
Material and Appliances.

form the eye shown in Fig. 44; holding the eye at *c* with the left hand, pass the end *a* under the standing part of the rope *b*, bring it up and then down through the eye as shown in Fig. 45; the knot when drawn tight appears as in Fig. 46.

Fig. 44.

Fig. 45.

Fig. 46.



Use.—To form a loop at the end of a rope which will not run up, or tauten.

Running Bowline Knot is commenced in the same way as the single bowline only, the bight is made so as to be *away* from the body and the standing end towards it; pass the end in the right hand under the standing end, take a turn round it, and make a bowline knot on itself, just in front of the hands, as shown in Fig. 47.

Fig. 47.



Use.—To form a loop at the end of a rope which will readily tauten up.

Material and Appliances.

Single Wall Knot.—To make it, unlay the end of a rope,* Figs. 48 and 49, and with the strand *a* form a bight holding it down on the side of the rope at *b*, passing the next strand *c* round the strand *a*, the end of the strand *d* round the strand *c*, and through the bight which was made at first by the strand *a*; then haul them rather taut, and the knot will appear like Fig. 50. When quite taut the top will appear as in Fig. 51.

Use.—This knot is used in the shroud knot, and in the wall and crown knot.

Fig. 48.



Fig. 49.



Fig. 50.



Fig. 51.



* It is advisable, whenever a rope is untwisted, to "seize" it just below where it is unlaid, and also to whip the ends of the strands.

 Material and Appliances.

Crowning Wall Knot.—To crown the single wall knot is to lay one of the ends, *a*, over the top of the knot, Fig. 52; lay the second, *b*, over it, and the third, *c*, over *b*, and through the bight *a*; haul them taut, and the knot will appear like Fig. 53.

Fig. 52.



Fig. 53.



The double wall and double crown knots are easily made from the above, the ends being previously whipped, Figs. 54 to 60. These knots are generally used to prevent the end of a rope from slipping through an eye.

Fig. 54.



Fig. 55.



Fig. 56.



Fig. 57.



Fig. 58.



Material and Appliances.

Fig. 59.



Fig. 60.



Use.—To form a knot at the end of lever and other ropes.

Single Diamond Knot.—This knot is made by unlaying the end of a hawser-laid rope for a considerable length, Fig. 61, and with the strands forming three bights down its sides, holding them fast; the end of the strand *a* is placed over the strand *b*, and through the bight of the strand *c*, as represented in Fig. 62; the strand *b* is put over the strand *c*, and through the bight formed by the strand *a*, Fig. 63, and the end *c* over *a*, and through the bight of *b*, Fig. 64; haul these taut, lay the rope up again, and the knot will appear like Fig. 65.

Fig. 61.



Fig. 62.



Fig. 63.



Material and Appliances.

Fig. 64.



Fig. 65.



Use.—To form a knot on a rope to keep the hand from slipping.

Matthew Walker's Knot.—This somewhat resembles a wall knot.

Fig. 66.



Fig. 67.



Fig. 68.



Fig. 69.



Material and Appliances.

Unstrand for a length in proportion to its size a three-stranded rope, and call the strands 1, 2, and 3, Fig. 66; then strand No. 1 is to be passed round the rope, below the other strands, and through its own bight. No. 2 strand is then to be passed round the rope, through the bight of No. 1, and then through its own bight, Fig. 67. No. 3 is then to be passed round the rope, and through the bights of 1 and 2, and then through its own bight, Fig. 68; then haul taut, Fig. 69.

Use.—Same as Diamond Knot, Fig. 65.

Drag Rope Knot.—Figs. 70, 71, 72.

Fig. 70.

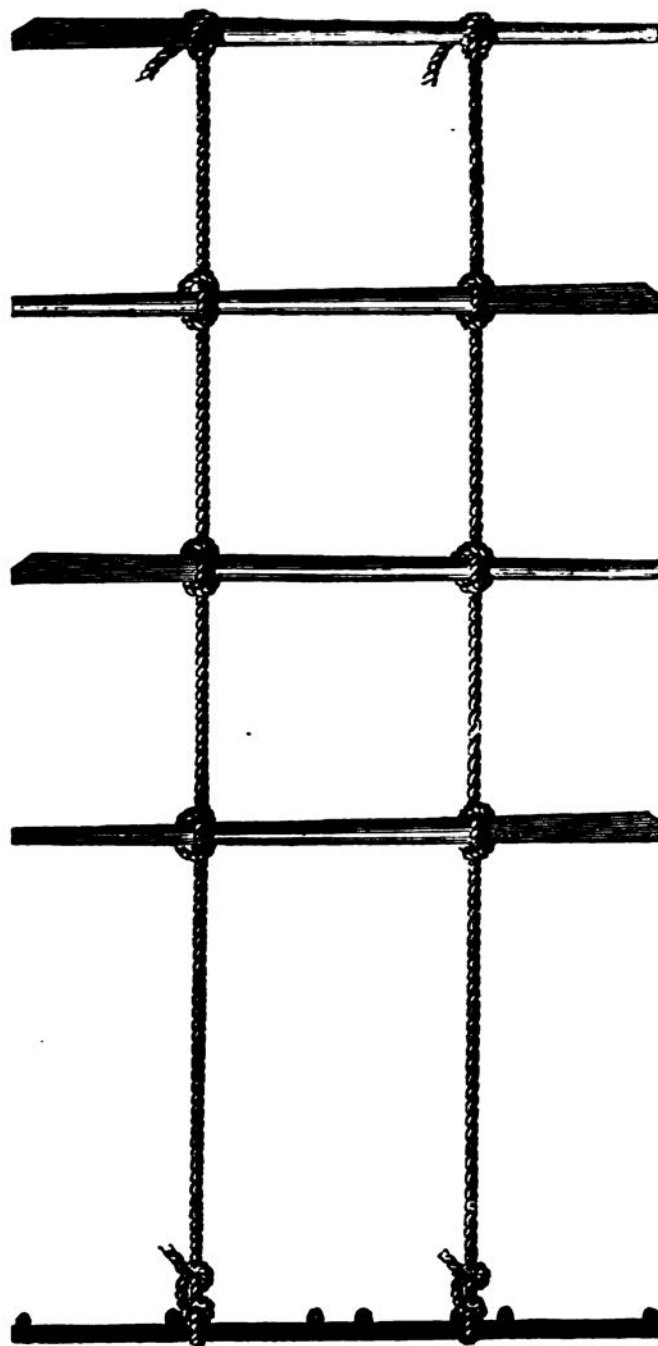


Fig. 71.



Material and Appliances.

Fig. 72.



Use.—Attaching handspikes to drag or parbuckle ropes in order to man and heave on them.

 Material and Appliances.

Man Harness Knot.—Figs. 73, 74, 75, 76.

Fig. 73.



Fig. 74.



Fig. 75.



Fig. 76.



Use.—For convenience in heaving on drag ropes.

Woolding or Packing Stick Knot.—It is difficult sometimes to secure a load on a carriage so firmly that it may travel without loosening. The lashing ropes may be hauled taut by means of a woolder or stick about $2\frac{1}{2}$ feet long, its length depending upon circumstances.

Material and Appliances.

If the ends of the rope which secure the load have not been made fast, make a loop, *b*, on one end of the rope, and pass the rope round the load. Bring the other end, *a*, through the loop, through which also pass the woolder, Fig. 77; then take two turns with the running end *a* under the stick, and between it and the rope surrounding the load, Fig. 78. Then turn the woolder round in a direction contrary to that in which the end *a* was turned, until the load is firmly secured, and lash it to the rope going round the load, or to any other convenient place.

Fig. 77.



Fig. 78.



If both ends of the rope are fastened, a drag rope knot or lever hitch may be used, Figs. 79, 80, 81, the woolder being twisted round, and secured as before detailed.

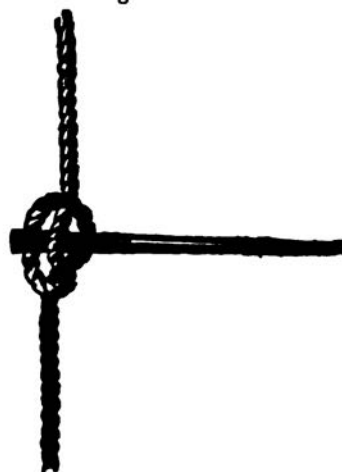
Fig. 79.



Fig. 80.



Fig. 81.



Use.—For tautening lashings.

Material and Appliances.

Shroud Knot.—This knot is useful for joining two ropes together, and does not require so much of the rope to be unstranded as a splice.

The two ends are opened, more or less, according to the size of the rope, and interlaced one with the other, as for splicing, Fig. 82; a single wall knot is then made on each end, round the standing part of the opposite rope, Fig. 83; the ends are then laid in the intervals between the strands, and served over with spun yarn, Fig. 84.

Fig. 82.



Fig. 83.



Fig. 84.



Use.—Instead of a short splice, being more easily and rapidly made.

BENDING.

Bending ropes together consists in uniting them in such a manner that, whilst they bite more readily, they can also be separated more easily than when knotted.

Single Bend.—Pass the end *a*, Fig. 85, of the rope *b* under and through the bite of the other rope, *c d*, then under and round both parts of the rope *c d*, over the bight of the same, but under the standing part of its own rope *b*; then draw the ropes together, and the knot will appear as at Fig. 86.

Material and Appliances.

Fig. 85.



Fig. 86.



Use.—Joining two ropes or securing a rope through an eye splice.

When two heavy ropes are bent together on which there will be a great strain, a small piece of wood or the helve of a maul should be placed in the bend, so that it may be knocked out previous to unbending, and thus a place left for the point of a lever to prize the bends apart.

Double Bend.—An addition is made when a small rope is bent on to a larger by passing the end *a* a second time round the bight of the rope, and bringing it again under the standing part, *b*. Figs. 87, 88.

Fig. 87.



Fig. 88.



Use.—Same as single bend, but specially applicable in bending a small rope on to a larger one.

Material and Appliances.

Carrick Bend.—Lay the end, *a*, of a hawser or chain, *a b*, underneath its standing part, as in Fig. 89, then working round with another, *c d*, lay its end under both parts of the eye formed by *a b*, and parallel to the part which is uppermost. Then bring it alternately over and under the parts of *a b* and itself till it arrives at the point *c*, Fig. 90, and haul taut.

Fig. 89.



Fig. 90.



Use.—Bending two heavy hawsers together. By seizing back the loose ends with spun yarn, this bend may be kept from ever tautening up to an extent which would cause it to jam or be hard to cast loose.

Material and Appliances.

Hawser Bend is a half hitch with the end seized in two places, *f* and *g*, and the end of another hawser, *b*, passed through the bight, and hitched in the same way. Fig. 91.
Two half hitches on each hawser make the fastening more secure.

Fig. 91.



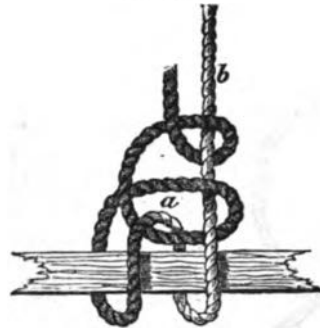
Use.—Bending two heavy hawsers together, or for forming a loop at the end of a heavy rope into which to hook a block, heavy ropes being too rigid to make a “cat’s paw.”

N.B.—By taking a complete turn with one rope through the loop of the other before making the half hitches, the strength of the bend is largely increased, more bearing surface being obtained, and the tendency to part at the loop to a great extent done away with.

Material and Appliances.

Fisherman's Bend.—With an end of the rope take two turns round a spar, Fig. 92, then a half hitch round the standing part *b*, and under the turn *a*, then another half hitch round the standing part *b*.

Fig. 92.



Use.—Principally for making fast to anchors or iron rings.

HITCHES.

Hitches may be described as overlaying a part of a rope with itself in such a manner that a loop or loops are formed to jam on each other.

Half Hitch.—Is made by passing the running end, *a*, of a rope round the standing part, *b*, bringing it up through the bight *c*, it may be seized to the standing part at *d*, Fig. 93.

Two half Hitches.—Fig. 94; after making the first half hitch, make a second in the same manner, and seize if necessary as before.

Fig. 93.



Fig. 94.



Use.—Making fast a rope end to an object.
(A. M.)

Material and Appliances.

Clove Hitch.—Two loops or bights, *d, e*, Fig. 95, are made, and the right placed over the left, as at Fig. 96, and used as in Fig. 97, and hauled close.

Fig. 95.



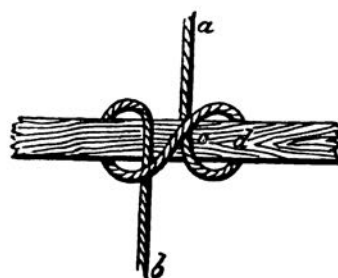
Fig. 96.



Fig. 97.



Fig. 98.



Should the hitch be required round an object, over which it would be impossible to pass the loop, then the running end *a*, Fig. 98, is passed round the object, and brought up on the left side of the standing end *b*, again passed round the object at *d*, in the same direction, and brought up under itself at *c*, Figs. 98 and 99; both ends are then hauled taut, and the knot closed as at Fig. 100.

Material and Appliances.

Fig. 99.

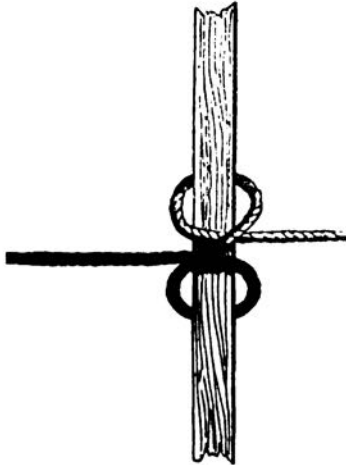


Fig. 100.

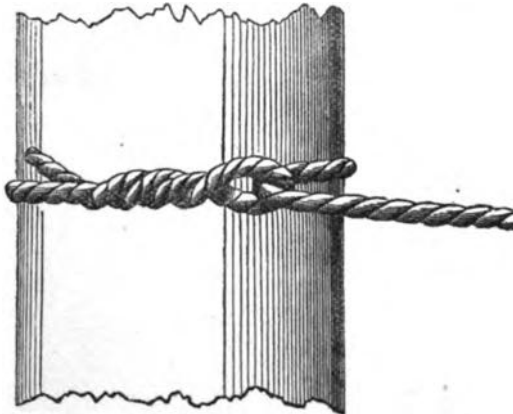


Use.—Making fast the bight of a rope.

Timber Hitch.—Is made by passing the end of a rope round a spar or piece of timber, Fig. 101, leading it round the standing part, and passing several turns round itself, then hauling taut.

A strap should always be made use of, when a cutting strain is likely to come on a rope by making fast with itself.

Fig. 101.



Use.—Making fast to beams, &c.

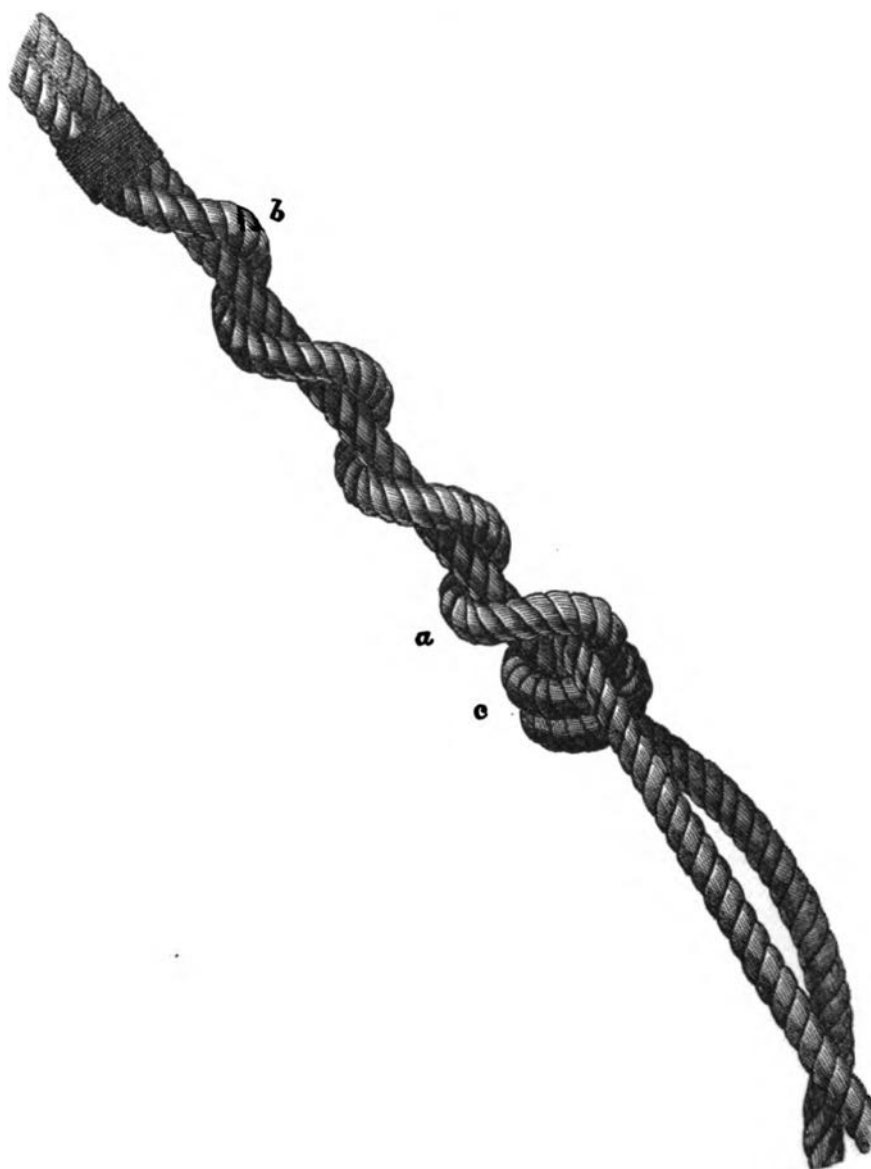
Stopper Hitch.—The rope or *stopper* is passed twice round the rope having the strain or *to be stoppered*, the end coming off below. It is then laid across its own standing part towards the direction of the strain, and turns taken in the opposite direction above and seized.

(A. M.)

2 B 2

Material and Appliances.

Fig. 102.



Use.—To transfer the strain from one rope to another.

N.B.—If the two first turns at *c* be applied so as to be at right angles to the “lay” of the other rope, and the remainder of the turns to lie *with the lay*, the holding power of the hitch will be materially increased.

Material and Appliances.

Single Blackwall Hitch.—Is made by putting the bight of a rope over the hook of a tackle, &c., as represented by Fig. 103, letting the part *b* rest upon it, and the end *a* be jammed by the standing part of the cross.*

If the loose end, *a*, is seized down to *b*, the hitch is rendered very secure.

Fig. 103.



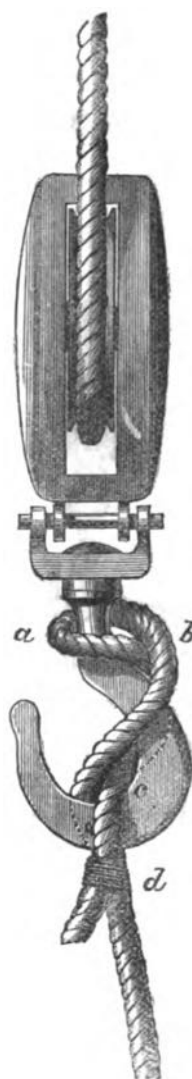
Use.—Securing a tackle to a rope.

* This is liable to slip, and is never to be used where a slip would cause damage, either from a loss of strain or when the rope becomes wet, and is only applicable to ropes of 2½ inches and upwards.

Material and Appliances.

The Double Blackwall hitch is much more secure than that last described. It is made as follows :—

Fig. 104.



Place the rope, near its end, against the hook of the block at *a* (Fig. 104), cross the returns at *b*, and again at *c*; if seized at *d*, additional security is obtained.

Material and Appliances.

Packing Hitch.—For shortening slings.

Lay the bight under or over both parts, which will divide it into two loops; turn each of them the same way over several times, bring them together, and hook the tackle through both, Figs. 105, 106.

Fig. 105.

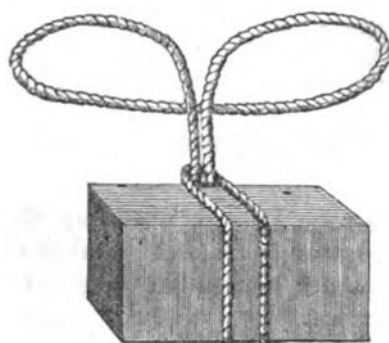
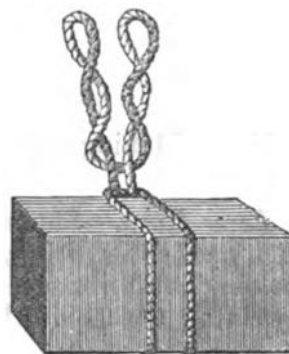


Fig. 106.



Magnus Hitch.—Is made by passing the end of a rope twice round a spar *c*, Fig. 107, then bringing it before the standing part *b*, passing it again round the spar at *d*, and up through the bight which it made, the end part being jammed by the bight *e*, Fig. 108.

Use.—For making fast to round spars.

Fig. 107.

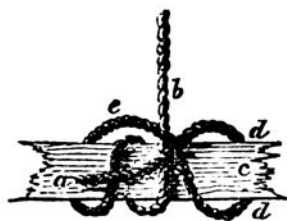
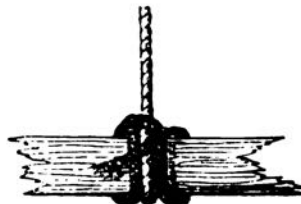


Fig. 108.



Rolling Hitch.—With the end, *a*, of a rope, Fig. 109, take two turns over the spar, at *c*, then pass two half-hitches round the standing part *b*, and tauten them, or if the rope is very stiff the end may be seized as shown in Fig. 109.

This is a very good hitch, and always easy to cast off.

Material and Appliances.

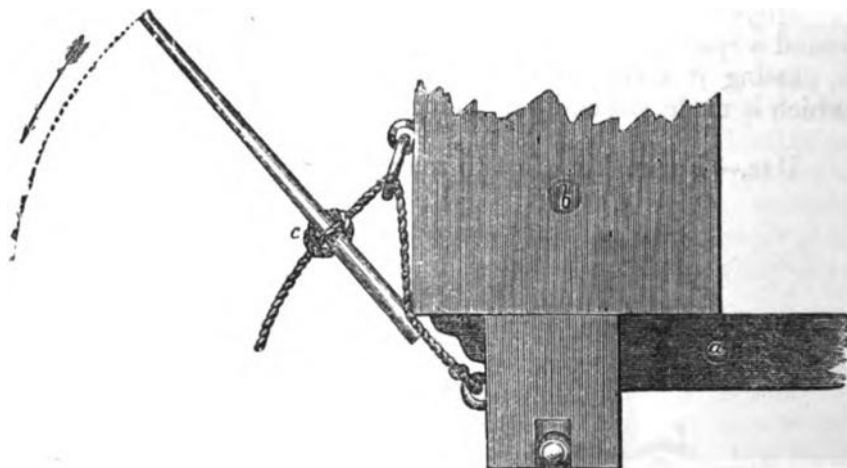
Fig. 109.



Use.—Making fast a rope end round an object.

Lever Hitch.—Similar to the drag-rope knot or woolding stick hitch, and is used for tightening ropes, but instead of turning the woolding stick round, it is applied on the principle of the lever, Fig. 110. (See Fig. 81.)

Fig. 110.



Use.—Tightening ropes.

In lashing on, for example, the ammunition box *b*, Fig. 110, to the carriage *a*, to tighten the rope a drag-rope hitch, *c*, is made, and the lever passed into it, one end being made to rest against any spot below the handle. After heaving the lever down, should the rope not be sufficiently tight, a fresh purchase must be taken.

Sheep Shank.—Serves to shorten a rope without cutting it; it may be immediately undone, and the rope not injured, Figs. 111, 112.

 Material and Appliances.

Fig. 111.



Fig. 112.



The part of the rope it is intended to shorten, is divided into three equal portions laid parallel to each other: a half hitch is to be made in each of the outer parts, as represented in the figures, observing that that part of the hitch or loop which leads to and communicates with the running ends of the rope is to be inside, as is represented in Fig. 112, where the knot appears completed and drawn close.

Catspaw.—Two loops made on a rope, in order to hook a tackle on.

Take one part of a rope, *a*, Fig. 113, in the right hand, and lay it over the standing part, *b*, held in the left, which will form the bight *c*; both parts are then held together at the crossing *d*, by the left hand, the middle part, *c*, of the bight is then taken with the right hand, the thumb under, and the fingers above, and turned over from you, laying it on the crossing *d*. Two equal bights, *e* and *f*, will now be formed, which are to be taken firmly, one in each hand, Fig. 114, and turned over upwards, rolling them along the standing part *b*, (which is to be kept taut,) and towards the running part, *a*, Figs. 115, 116. They must be rolled or turned round, until the standing part, *b*, has gone thrice round them, Fig. 116, and they will be equal in length; the middle parts of each bight are then to be brought together, and a tackle hooked to them, Fig. 117.

Material and Appliances.

Fig. 113.

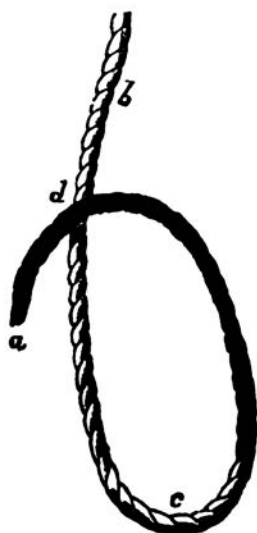


Fig. 114.

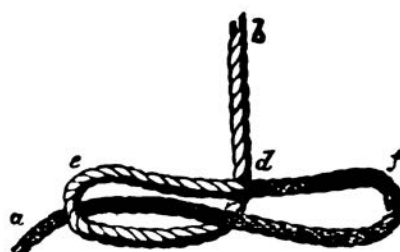


Fig. 115.

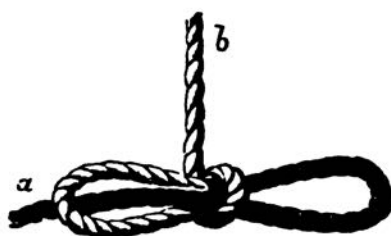


Fig. 116.



Fig. 117.



Material and Appliances.

CLINCHES.

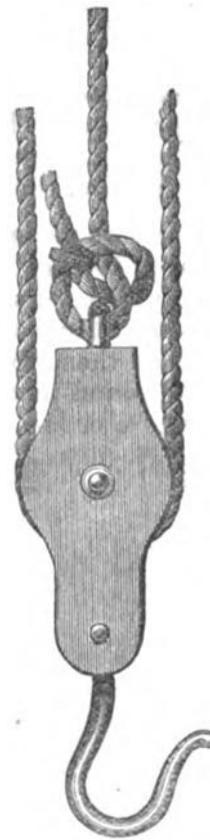
Clinching is a method of fastening large ropes by a knot and seizings, and is used for the breechings of guns, attaching the standing end of the fall to the block in tackles, &c.

Inside Clinch is made by passing one end of the rope through the object, leading it round the standing part, through the bight, forming a circle; two seizings are then put on the circle, and the whole will appear as Fig. 118. The clinch for tackle has generally only one seizing, Fig. 119.

Fig. 118.



Fig. 119.

**PARBUCKLE ROPES.**

The ropes used for parbuckling guns are $4\frac{1}{2}$ -inch tarred, with a hook spliced into one end, 18, 15, and 12 fathoms in length, and the 6-inch parbuckle rope (white) 18 fathoms long.

Material and Appliances.

DRAG ROPES.

Drag ropes are of two natures, heavy, which are of 3-inch white rope 5 fathoms long, and light, of 2-inch white rope 2½ fathoms long, for field service. A hook is spliced into one end of each. They are principally used for hooking to artillery carriages for manual draught, but may be used as found necessary.

STRAPS, SELVAGEES, GASKETS, AND STOPPERS.

Straps—Are usually made of rope, the ends of which are either spliced or secured together; they are used for passing round anything to be moved by rope or tackle, the hook being passed through the bight at both ends, or one after it has been passed through the other.

Selvagees—Are formed of returns of spun yarn turned into a circular form and bound together. They are used for the purpose of attaching the hook of a tackle, the selvagee being passed round the object and the tackle hooked to the bights.

They are made in the following manner:—Plant two pickets or pins at a distance from each other, equal to the intended length of the selvagee. Pass or wind returns of spun yarn round them until the selvagee is sufficiently thick for the purpose intended; then bind them together with the running end of the spun yarn hitched round them, each half hitch being at the distance of an inch, more or less, Figs. 120 to 123.

Fig. 120.



Fig. 121.



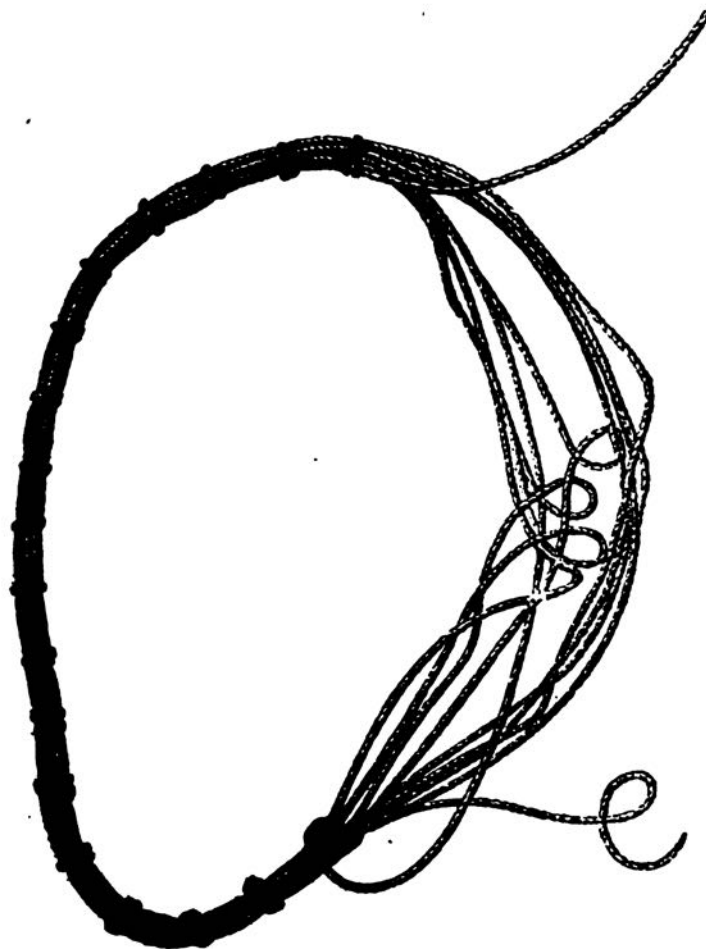
Material and Appliances.

Fig. 122.



A better plan is to knot each of the half hitches by passing the running end from the front through the loop, Figs. 123, 124.

Fig. 123.



Material and Appliances.

Fig. 124.



To apply a selvagee to a rope, lay the middle part of the selvagee over the rope, as in Fig. 125; then bring both bights under and round the rope in opposite directions, passing the bight *a* through the bight *b*, or the bight *b* through the bight *a*, as it may happen, Fig. 126; bring both bights together, and place the hook in them, Fig. 127; then haul or ease off as the case may require, Fig. 128. The selvagee being very pliable, there is great friction between it and the rope it is applied to, still it should be used with caution (particularly when the latter is small or smooth), and never, when the selvagee slipping would be liable to cause an accident, or injury to material.

A gasket put on with a stopper hitch is much safer; in this case the block is hooked into the eye at the thick end of the gasket.

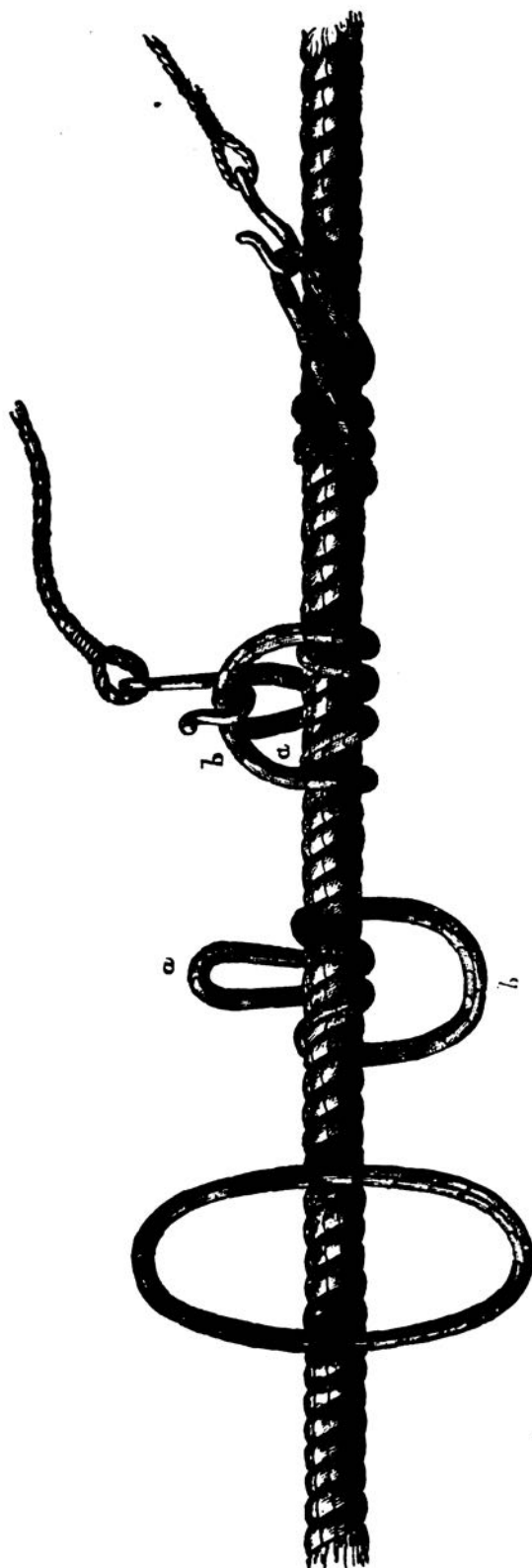
Material and Appliances.

Fig. 128.

Fig. 127.

Fig. 126.

Fig. 125.



Material and Appliances.

**TABLE OF SELVAGEES FOR SLINGING PROJECTILES OF R.M.L.
GUNS, 9-INCH TO 12-INCH, OF 25 TONS.**

Selvagees are used for slinging projectiles of the above-mentioned natures when loading.

The following are the sizes required:—

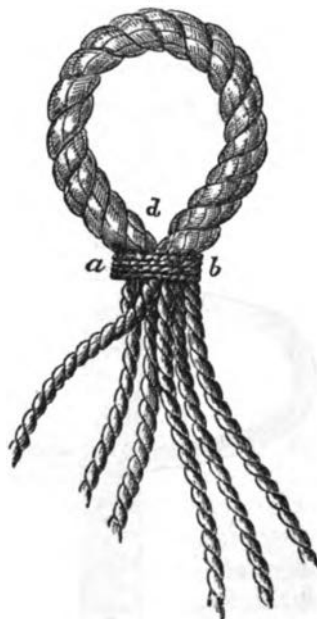
	No. of Strands.	Length in the double.
9-inch	22	37 inches.
10-inch	22	41 „
11-inch	26	43 „
12-inch (25 tons) ..	26	46 „

GASKETS.

Gaskets.—Are made of rope, unstranded and plaited. Being flexible and flat, they are preferable to a rope as stoppers. The gasket made with an odd number of strands is always neater than one made with an even number: in the latter case the division which appears in the rope is not in the middle of it, and one side is broader than the other.

To make a gasket a piece of rope double the length of the required gasket is taken, and the end *a* is doubled down on the standing part *b*, Fig. 129, and seized, according to the size it may be intended to make the loop. Untwist the strands of the rope completely, and separate all the yarns one from the other; then divide into any uneven number of equal portions thought proper.

Fig. 129.



Material and Appliances.

To make a gasket with three strands, Fig. 130, form the bight *d* in the rope *a, b*, and seize it at *a, b*; unstrand the rope up to the seizing, and call the strands 1, 2, 3, and 4, 5, 6, counting from the middle outwards on each side; interweave these strands as follows:—Pass 1 over 4 and under 5, and unite it to 6, Fig. 131; 2 and 5 to work together, and 3 to work with 4, which crosses under 1. In the figure the yarns of the rope have not been opened out; it has been only unstranded, that a clearer idea might be given of the first arrangement of the yarns than would have been the case had the yarns been separated.

Fig. 130.

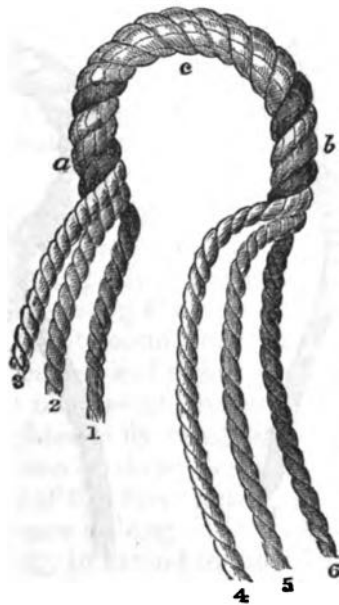


Fig. 131.



Material and Appliances.

The strands having been arranged as described, the whole of the yarns are to be opened out up to the seizing, and 1 and 6 as now united, called No. 1; 2 and 5 No. 2; and 3 and 4 No. 3; Fig. 132; the operation of plaiting is then commenced, by bringing No. 3 over 2, Fig. 133, then No. 1 over 3, Fig. 134; then No. 2 over 1, Fig. 135, &c.; the outside portions of the rope being alternately passed over the middle portion, and under each other, Fig. 136.

Fig. 132.



Fig. 133.



Fig. 134.



Fig. 135.



Fig. 136.



Material and Appliances.

As it may be wished to taper it off, a yarn or two is taken from No. 1, and after working a little, the same number may be taken from No. 2, and afterwards as many from No. 3, or they may be taken from each at the same time, so that by gradually cutting off yarns the gasket is diminished.

Stoppers—Are gaskets or short pieces of rope used to keep any weight suspended or to take the strain off a rope; a gasket is preferable, being very pliable. One end of the stopper is always attached to some fixed object.

LASHING.

Lashing—Is the securing together any bodies by means of ropes; there are two descriptions generally used, namely, *square* and *diagonal*. The nature of rope depending upon the work to be done.

Square Lashing.—Make fast one end of the lashing rope to one of the objects to be lashed, the fixed, if there be one, by a timber or clove hitch, or passing the eye end of the rope under it, bringing it up and passing the other end through the eye; then after hauling taut, pass it round the second object, round the first, up again round the second, and down round the first, continuing this until a sufficient number of returns are made, when the whole of the returns are tightened by bringing the end round the returns between the objects two or three times, and making fast with two half hitches on either of the first returns, or one of the objects.

In applying a square lashing, it is necessary in order to keep the returns from riding, to attend to the following point; namely—

If the returns on one of the spars (say the upper one) lie in succession *outside* the returns first applied, the returns must lie in succession *inside* those first applied on the other spar.

It is quite immaterial whether they lie outside the first returns on the upper or the lower spar.

Square lashing is generally used for securing beams or spars at right angles to each other, or approximately so.

Diagonal Lashing.—The end of the rope is made fast as before. The rope is then passed diagonally over the two objects as often as may be required; the direction is then changed by bringing the end up over one of the objects and a few turns taken opposite to the last, diagonally over the two, the end being secured as before.

FISHING SPARS.

Fishing Spars—Consists in strengthening spars by lashing other spars parallel to them.

The fishing spars should be placed against the spar to be fished, so that they may take off as much strain and be in as close contact

(A. M.)

2 c 2

Material and Appliances.

as possible. The lashing rope or ropes having been made fast by one end being laid along the spars so as to be covered by the returns, are then passed round and round all the spars until, as it were, one spar is formed, the end being made fast by taking the last four or five returns rather slack, the end then passed backwards under them, the returns tightened up, and the slack hauled through.

Several separate lashings may be applied instead of one continuous one.

FRAPPING.

Frapping—Is the drawing together the several returns of the rope.

The rope used for frapping is generally the running end of the rope itself, or it may be any other rope adapted for that purpose, Fig. 137.

Fig. 137.



After having frapped, the end of the rope is made fast by two half hitches, one being made round all the returns, the other on one half only.

BLOCKS.

Blocks or Pulleys—Are the means by which the direction of the motions of ropes may be changed with as little friction as possible, by passing over small flanged wheels called "sheaves," so that they may run freely.

Blocks are made of wood or iron, the latter being only used exceptionally; they are composed of the following principal parts, namely, strap, shell, pin, sheaves, shackle, hook.

Blocks are designated by the length of their shell in inches measured on the outside, and by the number of sheaves.

Blocks will take a rope the circumference of which is equal to one-third of their length; thus an 18-inch block can take a 6-inch rope, a 15-inch block, a 5-inch, and so on.

Material and Appliances.

The blocks used in Artillery Service are single, double, treble, and snatch, and are of the following dimensions, 21, 18, 15, 12, 10, 9, and 8-inch.

There are two descriptions of blocks, namely, Admiralty and Bothway's.

Admiralty blocks are a simple wooden shell bound on the outside, in the direction of their length, with a rope strap, which is called "the strap" of the block.

Bothway's blocks are iron strapped, the strapping passing inside the shell, and affording a better support to the pin, upon which the sheaves turn, than the Admiralty block does. These blocks are fitted with swivel hooks.

The shell of Bothway's block is built up of several parts instead of being cut out of one solid piece. These parts are rivetted together. The iron strap is also in separate parts.

Each division of the block has its own strap, which being pierced in the middle to receive the pin, affords the latter great support.

Sheaves of blocks should work quite true on the pins, which should from time to time be examined.

The shell of a block in use should not press against anything.

TACKLES.

A simple tackle consists of one or more blocks rove with a single rope, or "*fall*."

When a tackle is in use, one end of the fall is made fast; the other is hauled upon.

The fixed end is called the "*standing end*" of the fall. The other the "*running end*."

Each separate part of the fall contained between two blocks, or between either extremity and a block, is called "*a return*" of the fall.

To *overhaul* a tackle is to separate the blocks. This should invariably be done from the standing and not from the moveable block.

To *round in* a tackle is to bring the blocks closer together by hauling in the fall.

The following will be found to be a convenient way of overhauling a heavy gyn or sheer tackle:—

The treble block from which the running end comes off is made fast with a selvagee or piece of lashing to some heavy object or holdfast, a handspike is placed through the hook of the other block, and a drag rope made fast to it. To overhaul the tackle four men man the handspike, hold up the block and endeavour to walk away with it, in which they are assisted by a few numbers on the drag-rope, whilst one or two men overhaul the returns at the standing block.

In this way the heaviest tackles may be quickly overhauled.

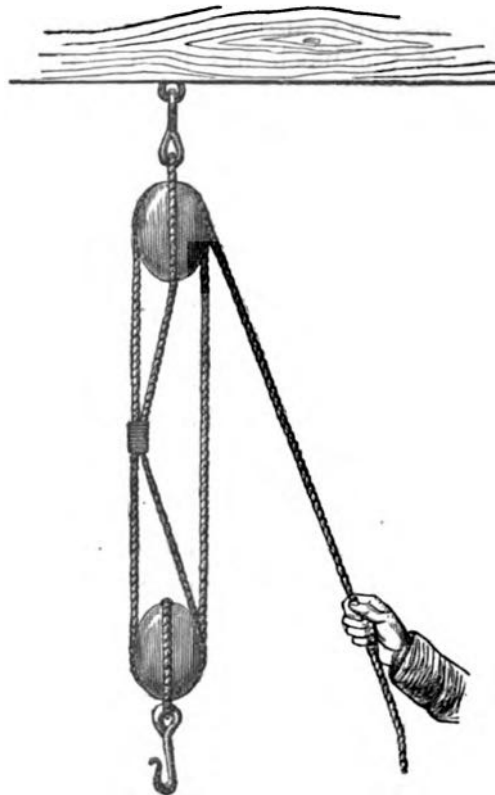
Material and Appliances.

Rounding in is the converse: the Nos. on the drag-rope and handspike hang back, whilst a few Nos. heave on the running end.

The main object of the handspike both in overhauling and rounding in is to keep the tackle out of the dirt, which would clog the sheaves and greatly counteract the good effects of lubrication.

To *rack* a tackle is to fasten any two opposite parts or returns of a tackle together, so that the blocks may retain their relative position although the running end be let go, Fig. 138.

Fig. 138.



The following are the principal points to be attended to in the arrangement and use of tackles, viz.:—

The condition and strength of the straps, blocks, and cordage.

That the fall is free from kinks and turns, and enters freely into the grooves of the sheaves.

That the returns and running end of the fall do not press against the shell. No block in good working order should "*complain*," that is make a noise; to diminish friction, as far as possible, the blocks should be clean and well lubricated.

Material and Appliances.

The nature of the fastenings should be such as to ensure perfect security, particularly that of the standing end.

The proper stoppering of the fall, the "stopper" equalling in strength the rope it is to hold.

The fall when taut is not to be jarred by being struck or by men treading on it.

The position of the men should be such as to ensure the greatest amount of safety to themselves, in the event of accident.

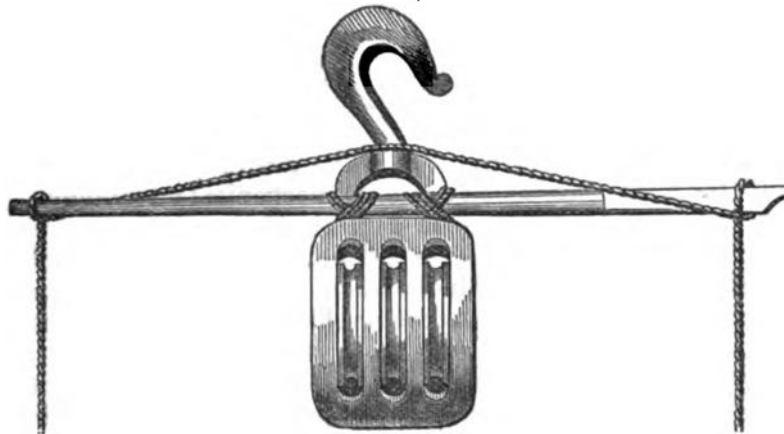
The men to be habituated to pull together, silently. At the caution, *taut*, the slack is hove in, and at the word, *heave*, they pull together and keep what they get. When the site is limited they fall off and take a fresh hold in front of the other numbers in succession, as soon as they arrive at the end of their beat.

It will be found in using tackles that they twist very much, especially very long tackles. This should, when practicable, be prevented, and may be done as follows:—

By placing a handspike or picket post at right angles between the returns close to the block, the handspike being kept in its place by a lashing or drag-rope at either end held on by two men or made fast to any fixed object.

Another and better method is by lashing a handspike across the movable block (Fig. 139), with a rope attached to either end of the handspike, held on or made fast as before.

Fig. 139.



To prevent long tackles, such as the main tackles of sheers, from twisting, it is a good plan to reeve them so that the running end comes off from a *centre* sheave. There is not room between the spars at the head of sheers to rig anti-twisters, and the blocks must be free to swing fore and aft in heeling.

Tackles may also be prevented from twisting by leading the running end of the fall through a leading block made fast some distance to the right or left of the place where the tackle itself is hooked.

Material and Appliances.

Twists can often be taken out of a tackle by merely twisting the blocks round either by hand or by placing a handspike between the returns, and using it against them as a lever.

This will not, however, prevent the twist coming in again when the tackle is subjected to a heavy strain.

A properly stretched fall and the use of anti-twisters on the blocks, wherever practicable (or other preventive measures), will amply repay the time and trouble expended on them by guarding against twist.

The most advantageous application of a man's power in hauling is in a slanting direction downwards, as his weight is added to his strength.

It not unfrequently happens, when a weight is to be moved, that from the nature of the ground, or other unavoidable circumstances, the men employed in the operation cannot apply their strength immediately in the direction in which it would be most effective. In such a case, a single block is made fast to a point in the direction in which it is intended that the weight shall be hauled upon. A single block so fixed is called a *leading block*. The rope made fast to the weight is then passed round the sheave of the block; and the men can haul in any direction that may be most convenient.

In fixing a leading block it ought, if possible, to be made fast at the height of the hips, that the men may pull in an advantageous position. They either *walk away* with the rope, or haul *hand over hand*, keeping their ground, and shifting their hands alternately, one over the other, so as to *keep what is got*.

The power gained in the case of a simple tackle is represented by the sum of all the returns of the fall, which act immediately upon the moveable block.

The following tackles are used in the Artillery service:—

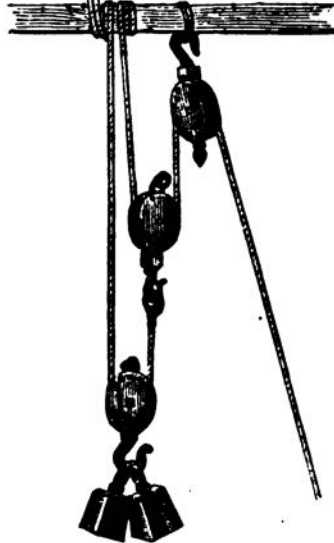
- (1) *One fixed block* which gives no mechanical advantage.
- (2) *One moveable block* which doubles the power.
- (3) "*A luff tackle*" consist of a double and single 8-inch block, with a fall of $2\frac{1}{2}$ -inch rope, which, when the single block is moveable, trebles the power; when the double, it increases the power fourfold. Fig. 140.
- (4) "*A gun tackle*" consists of two double blocks. When the standing end of the fall is made fast to the moveable block the power is increased fivefold; when made fast to the other fourfold.
- (5) "*A heavy gun tackle*" or 16-foot "*light gyn tackle*," consists of a double and treble block, which increases the power five or six times, as used.
- (6) "*A gyn tackle*" consists of two treble blocks, and a power of six or seven is gained.
- (7) "*A whip upon whip*" consists of two moveable blocks, one of which is applied to and acts upon the running end of the fall of the other. It increases the power fourfold. There is less friction in this combination than in a luff tackle; it is used in running back at drill, Fig. 141.

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Fig. 140.



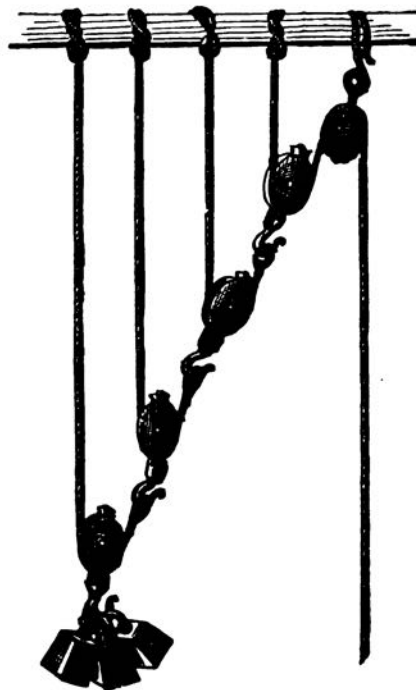
Fig. 141.



(8) "*A runner tackle.*"—A tackle applied to the end of a rope passing through another block, or, in other words, a tackle applied to the running end of the fall of another tackle, is called a runner tackle.

Combinations of tackles are occasionally used, *vide* Figs. 142, 143; the values of which depend upon their particular natures.

Fig. 142.



Power 16 to 1.

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In a *combination* of "tackles" where one acts upon the running end of another, the result of their combined action is found by multiplying together the values of the several simple tackles.

Fig. 143.

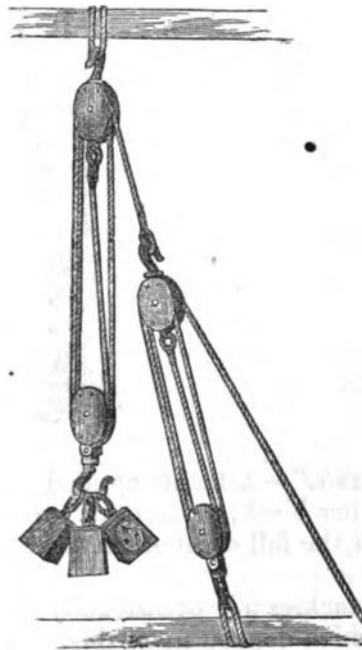


Fig. 143 shows a combination by means of 4 double blocks, yielding a power of 20 to 1.

The increase of power attributed to the foregoing systems is purely theoretical; practically very large deductions have to be made on account of the resistance arising from the stiffness or rigidity of the ropes and from friction. This subject is fully treated on at page 420, suffice it here to say that with a fair lead and clean and well lubricated blocks, an allowance of $\frac{1}{8}$ th of the weight raised has to be made for every sheave in use.

No more than six sheaves (or two treble blocks) can be used with effect in the same tackle, on account of the loss of power from friction and rigidity of rope.

In many operations of artillery, however, friction is of great use, inasmuch as it enables a small force, acting at one end of a rope, to sustain a great weight acting at the other, if the precaution be taken to pass a few turns of the rope round a fixed object of suitable strength. A greater number of turns must be taken round a small object than round one of larger dimensions.

The use of tackles, levers, and other mechanical contrivances, affords an increase of power, only at the expense of time or space. In addition to the loss of time in the actual operation, that caused by the preparation and adjustment of the mechanical contrivance made use of has also in many cases to be considered.

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TABLE OF SERVICE TACKLES.

Description.	Blocks.					Rope.			Working Strain of Tackles.	Remarks.
	Nature.	Size.	Treble.	Double.	Single.	Size.	Length.	White or Tarred.		
Luff	Bothway.	Ins. 8	..	1	1	2½	14	Tarred	Tons. 2	General purposes.
Guy Runner, light		8	..	1	1	2½	56	do.	2	Light Sheers or Derricks
16 ft. Gyn ..		10	1	1	..	3½	15	White	4*	With 16' Gyn.
18 ft. light Gyn		12	2	..	..	4	18	do.	7	„ 18' light Gyn.
18 ft. heavy Gyn		15	2	..	..	5	18	do.	11†	„ 18' heavy Gyn
Sheers or Derrick, light		12	2	..	..	4	113	do.	7	Light Sheers or Derricks, Main Tackle.
Sheers, heavy ..		18	2	..	..	6	113	do.	14	Heavy Sheers, Main and Guy Tackles.
Do. do. ..		21	2	..	..	7	113	do.	19†	Do. for 38-ton Guns, do.
Whip	Admiralty.	8	..	..	1	2½	7	Either	1	Running back Travelling Gun Carriages at drill.
Whip upon Whip		8	..	..	2	2½	14	do.	2	Do. Standing Garr. do.
Luff		8	..	1	1	2½	10	Tarred	2	Do. Guns below 4 tons, traversing platform.
Gun		8	..	2	..	2½	12½	do.	2½	Do. Guns from 4 to 5 tons, do.
Heavy Gun ..		9	1	1	..	3	16	White	4	Do. Guns above 5 tons, do.

The working strain of the above tackles is calculated for *worn* rope, and with the tackles arranged to give a theoretical power as follows, viz. :—

Luff Tackle	4 to 1 (if 3 to 1, the working strain is 1½ tons.)	
Guy Runner, light ..	4 to 1 (do. do.)	1½ "
16 ft. Gyn	5 to 1 (if 6 to 1)	5 "
18 „	6 to 1 (if 7 to 1)	8 "
18 „ heavy	6 to 1 (if 7 to 1)	12 "
Sheers or Derrick, light, ..	6 to 1 (if 7 to 1)	8 "
Do. heavy,	6 to 1 (if 7 to 1)	18 "
Do. for 38-ton guns ..	6 to 1 (if 7 to 1)	24 "
Whip	2 to 1	
Whip upon Whip ..	4 to 1	
Gun Tackle	5 to 1 (if 4 to 1)	2 "
Heavy Gun do. ..	6 to 1 (if 5 to 1)	3 "

The above being the way they are generally arranged for work.

The strains are expressed in round Nos. or approximately.

* This is the lifting power of the *tackle*, not of the *gyn*.

† This shows that much *worn* rope should not be used for heavy gyn tackle falls, as required for 12 tons, or for main tackles of heavy sheers for lifting 38-ton guns.

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Table of Weights of Service Bothway Blocks.

Nature.				Weight.			Weight. Expressed in lbs.
				cwt.	qrs.	lbs.	
Single ..	18-inch	..	..	1	2	9	177 lbs.
	15 "	..	..	1	0	26	138 "
	12 "	..	..	..	1	24	52 "
	10 "	..	..	..	1	11½	39½ "
	8 "	..	..	..	..	15	15 "
Double..	18 "	..	..	2	0	3	227 "
	15 "	..	..	1	2	5	173 "
	12 "	..	..	..	2	6	62 "
	10 "	..	..	..	1	21½	49½ "
	8 "	..	..	..	..	20	20 "
Treble ..	21 "	..	..	4	0	25	473 "
	18 "	..	..	2	1	24	276 "
	15 "	..	..	1	3	20	216 "
	12 "	..	..	..	2	23	79 "
	10 "	..	..	..	2	8	59 "
	8 "	..	..	..	..	27½	27½ "

TO REEVE TACKLES.

A tackle is rove by two men standing back to back about six feet apart, the blocks between their feet, hooks to their fronts, the blocks lying on their sides; the coil of rope being on the right of the block which is to have the greater number of returns. Beginning with the lowest sheave of this block, the end of the fall which is to be the standing end is passed successively through the sheaves from right to left, and made fast according to the nature of the block.

The only exception to this rule is with a gyn tackle or a left gun tackle where the reeving is from right to left, but through the highest sheave.

It is necessary when reeving *left* gun tackles (Admiralty blocks), to place the blocks hooks back up; when rove, if turned over, the tackle will be in the proper position for work.

The circumstances under which tackles may, with advantage, be rove with the running end coming off from a *centre* sheave will be found described at page 425.

To reeve a tackle so that the running end comes off from the centre sheave, pass what is to be the standing end of the fall through the centre sheave of one block, then through the centre sheave of the other, next through either the lower or upper sheaves of each block *consecutively*. One return must cross the centre one; but as they are moving at different rates (though in the same direction) the friction will be very trifling.

With the smaller natures of tackles the standing end is usually secured with an inside clinch, but the larger natures of Bothway blocks have a projecting stud in the centre of one side, to which

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the standing end is made fast. Should there be no stud the standing end may be secured to the neck of the block by two half hitches, and the end seized with spunyarn.

To reeve a Whip upon Whip.—Place the two single blocks, *a* and *b*, side by side on the ground, and pass the fall through both from right to left.

Fig. 144.



Fig. 145.



Bring the centre of the fall, *c*, back, and make it fast at the holdfast, *d*, carry the block, *b*, forward and turn it over, Fig 145, make fast the end of the fall, *f*, to the hook of the block *a*, and the tackle is ready for use.

CHAINS.

Chain is frequently substituted for rope when working with very heavy weights; previous to its employment every link should be most carefully examined to ascertain that all are in good condition, without flaw, and not too much worn.

In using chains there should be no kinks in the links, and if more than one return is round a weight, each return should bear its proper strain.

When it is necessary to connect the ends of a chain, it should be done with a shackle and bolt, or by means of a reef knot, which, if plenty of end is left, holds very well; for additional security the loose ends may be seized in two or three places.

The safe working load to which iron chain may be subjected, may be calculated by the following practical rule, square the diameter of the chain in eighths of inches, and cut off the last figure as a decimal, thus in a 1-inch chain:—

$$1'' = \frac{8}{8} \times 8^2 = 64 \text{ or } 6.4 \text{ tons.}$$

LEVERS AND HANDSPIKES.

Levers used in the service of artillery are made of ash or rock elm; they are of four sizes, namely, 8, 10, 12, and 14 feet in

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length. They are rectangular at one end, which is called the "point," the other or "small end" being oval.

Handspikes are smaller levers also made of ash, of the same form, except that one side of the point is bevelled off to a distance of about three or four inches, to admit of its being inserted into places where it would not otherwise enter, forming a fulcrum in pinching and rowing, and to admit of its being used as a scotch.

There are two descriptions of common handspikes in the service, namely, 6 and 7-feet; the 6-foot handspike is used with all guns up to 80 cwt., the 7-foot with all others.

Not more than two men should work with a 6-foot handspike or it may break.

FULCRUMS.

The term *fulcrum* means a support for a lever.

Any piece of strong timber of suitable dimensions may serve the purpose.

PRISMS.

Prisms are rectangular blocks of wood 16" x 6" x 5," bevelled on either side of the upper surface, and used for raising a gun out of the trunnion holes when a short skid cannot be got under it, in the construction of temporary gun sleighs for skidding the breech, &c., &c.

SKIDS.

Skids are rectangular pieces of wood (oak or fir) of various dimensions, used for placing under guns. The following are in the service :—

Size.		Purpose for which used.	
Skids, wood	20' x 15" square	fir	guns of 12 tons and upwards.
	20' x 9" "		below 12 tons.
	14' x 8" "		"
	6' x 12" "		general purposes.
	4' x 12" "		"
	14' x 5½" "	oak	40-prs. and 64-prs. siege.
	5' x 6" x 5"		general purposes.
	9" x 6"		"
	6" x 3"		"
	3' x 6" square		"
	4" "		"
	3" "		"
	10' x 13" x 8"	oak	for dismounting 12, 18, and
	10' x 15" x 9"		25-ton guns.
	11½' x 20" x 10"		38-ton guns.
	11½' x 20" x 15"		

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The weight and strength of skids are as follows:—

TABLE OF SERVICE SKIDS, showing their weights and the safe load they are calculated to bear, when supported for six inches at either end, and loaded in the middle, assuming them to be "selected" timber. If much worn or shaky they should be treated as "unselected" timber, and only subjected to half the loads given below:—

Nature of Skid.	Weight of Skid.		Safe load (being half the Breaking Weight).		Remarks.
	cwt.	lbs.	tons.	cwts.	
Skids.—Fir, 20' × 15" × 15" ..	11	18	14	10	Parbuckling, &c.
" " 20' × 9" × 9" ..	4	2	3	2	Do.
" " 14' × 8" × 8" ..	2	25	3	4	Do.
" " 6' × 12" × 12" ..	2	16	28	4	Skidding guns, &c.
" " 4' × 12" × 12" ..	1	48	47	2	Do.
" Oak, 14' × 5½" × 5½" ..	1	29	1	16	*Mounting guns, &c. (Siege train.)
" " 5' × 6" × 5" ..	0	50	{ 6 12		(On the edge.) } Transoms for
" " 3' × 9" × 6" ..	0	54	{ 5 10		(On the flat.) } sleighs, &c.
" " 3' × 6" × 6" ..	0	36	{ 35 14		(On the edge.) } Skidding guns,
" " 3' × 6" × 8" ..	0	18	{ 23 16		(On the flat.) } &c.
" " 3' × 4" × 4" ..	0	16	15 16		Do. do.
" " 3' × 3" × 3" ..	0	9	3 18		(On the flat.) } Do. do.
" " 10' × 13" × 8" ..	3	10	{ 22 0		(On the edge.) } For 12-ton gun.
" " 10' × 15" × 9" ..	4	2	{ 13 10		(On the flat.) } For 18-ton gun.
" " 11½' × 20" × 10" ..	6	24	{ 33 0		(On the edge.) } For 25-ton gun.
" " 11½' × 20" × 15" ..	10	0	{ 19 16		(On the flat.) } For 38-ton gun.
			{ 56 0		(On the edge.) } For 25-ton gun.
			{ 28 0		(On the flat.) } For 38-ton gun.
			{ 84 0		(On the edge.) } For 38-ton gun.
			{ 63 0		(On the flat.) } For 38-ton gun.

N.B.—Oak Skids are made of English Oak. Fir Skids of Memel, Riga, or Dantzic Pine, as may be available in the Royal Carriage Department. In the above Table the weight of the Fir Skids is calculated for Dantzic Pine, Riga would be about the same, and Memel somewhat lighter.

Skids should be supported on soft ground by laying sleepers of planks or fascines for them to rest on.

The heavy 20' × 15" skids do not require supports in taking 12-ton guns, they must be supported in the centre for heavier guns.

* If strengthened with iron plates these skids weigh 2 cwt. each, and the safe working load of each skid will be somewhat greater than that given above.

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The smaller nature of skids should have an intermediate support when bearing weights over 5 tons: as a rule support skids well.

When a succession of skids are used, they may be placed so as to overlap each other, and so avoid the necessity for the employment of other skidding to break joint.

PLANKS.

Planks are largely used in the artillery service for the following purposes, namely;—

1. Underneath skidding, when placed on soft ground, to obtain a large bearing surface, for which purpose planks of either oak or fir are suitable, according to circumstances.

2. On top of long fir skids, when parbuckling heavy guns; in this case the long oak planks are to be preferred, from their hardness and strength. When used on top of the breech skid, or skids, their object is to protect the fir skid from injury, and to cause the gun to travel easier, as, from the greater hardness of the oak as compared with fir, the gun will sink less into the supporting surface and hence experience less resistance to rolling. Placed on the muzzle skid, two or three deep, they both serve to keep the axis of gun horizontal, and facilitate cutting forward the muzzle, for which purpose they should be watered.

3. When moving guns on sleighs or rollers they may frequently be employed with advantage to form a roadway, in which case they should be placed with their ends overlapping to break joint. When used on soft ground they should be well and evenly supported. Long fir planks are generally used for plank roadways.

4. The short oak planks are often useful placed on top of fir skids in skidding up heavy weights, as they serve to distribute the pressure, and materially add to the strength of the supporting skid.

Fir planks should be hooped with iron at the ends to prevent their splitting.

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TABLE OF SERVICE PLANKS.

Planks, wood, fir, half	5' x 17" x 3"
" " " whole	10' x 17" x 3"
" " " "	12' x 9" x 3"
" " oak, half	..	..	..	6' x 12" x 3"
" " " "	..	..	..	4' x 12" x 3"
" " " whole	..	..	..	10' x 17" x 3"

ROLLERS.

Rollers are solid cylinders of wood (elm, sabicu or African oak) used in mounting and dismounting guns, shifting them from carriage to carriage or in moving them.

There are three descriptions, *ground*, *shifting*, and *gun*; their dimensions vary according to the nature of the service for which they are intended.

The *ground roller* is distinguished by its length and diameter. The African oak rollers are hooped at the ends with iron.

The *shifting* by their length, all being of the same diameter, namely, 5 inches.

The *gun roller* by having the nature of gun for which it is intended marked on one end; they have also a projection in the centre at either end to which a grummet is attached, and are made concave in the centre. Gun rollers are only issued with guns on travelling carriages.

Special gun rollers are issued for use with siege guns mounted on overbank carriages.

The following are the rollers in the service:—

	Nature.	Diameter.	Length.	
Rollers, wood	elm ..	10"	6'	ground.
			4'	
		6"	6'	
			3'	
		5"	3'	
	sabicu, 5"	...	2½'	shifting.
			3'	
			2½'	
			2'	
			20"	
	oak	12" 7' and 8'*	14"	iron-bound for heavy sleighs.
	gun..		64-pr. rifled gun.	
			40-pr. "	

* Weight, 400 lbs.

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The size of the rollers used in any operation should be in proportion to the weight to be moved, the largest possible should, as a rule, be used, as offering less resistance to rolling when moving over the inequalities inseparable from roadways of planks, skids, &c., &c.

In moving weights on rollers, it should be borne in mind that the rollers move over only half the space traversed by the weight they support, and that the weight travels in a direction at right angles to the axis of the roller, rollers should therefore be placed at right angles to the direction in which the weight is to move.

If rollers are slipping, use sand to make them bite.

On soft ground always place planks under rollers, the planks being as broad as possible and placed as close together as practicable, so as to give support to the rollers.

As a rule, move a gun on rollers breech foremost, the rollers being then more easily placed, also apply the power as nearly as possible at right angles to the direction of the leading roller.

SCOTCHES.

Scotches are generally made of elm, and are used for placing in front or rear of any weight to prevent it from moving; those in the service are:—

						Length.	Width.	Depth.
Large	..	..	..	..	..	12"	6"	6"
Medium	..	..	..	..	..	9"	5"	4"
Small	..	..	..	..	..	6"	4"	2½"
Scotch, wood, recoil, siege, carriage, for 40-pr. B.L.						4'	10½"	17"

No scotch should ever be placed under a weight which is to rest on skids, &c., until such weight is fairly resting on the same, unless orders to the contrary be given.

In order to avoid exposing the numbers to danger who may be following up with scotches in rear of a heavy gun when being parbuckled up inclined skids, handled scotches have been introduced; they consist of large service scotches fitted with a nut, tapped with a female screw in rear, into which an ash handle 6 feet in length is screwed: by this arrangement the numbers scotching up are enabled to stand well back clear of the weight.

Should the scotch jam and have to be mauled out, the handle should first be removed to save it from getting broken.

WEDGES.

Small wedges of oak or other wood are often useful for tightening up lashings.

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Wedges of oak 18" × 12" × 3" are issued for use when parbuckling guns; they are used as inclined planes to ease the passage of the gun from one skid to another when the skids are not exactly on the same level.

IRON PLATES.

Wrought iron plates, length 3 feet, weight 52 lbs., are used when parbuckling heavy guns, for placing on wooden skids to facilitate cutting forward the muzzle; two form a set.

PICKET POSTS.

Picket posts are made of ash, shod with an iron point at one end, and hooped with iron at the other to prevent their splitting when driven into the ground.

Picket posts for garrison service are 5, 6, and 8 feet in length, those for field service 2½ feet.

In future manufacture the heavy garrison 8-foot pickets will be made of pitch pine instead of ash, and be pierced in the head with a hole 2½ inches in diameter and 10 inches deep to receive the iron guide bar of the Swiss pile driver.

In driving pickets of different sizes the strongest should be nearest the weight, if they are of the same size, they may be grouped thus:—3 in front, then 2, then 1.

In lashing pickets together, make fast the lashing rope to the head of the front and lash to the feet of those behind, and frap next to the largest, so as to get the returns of the lashing as close together as possible.

To draw heavy pickets, the light triangle or Gibraltar gyn or sling wagon may be used with great advantage; they may also be drawn by the application of a long lever, the point being passed through a rope, chain, or gasket, round the picket, and a fulcrum conveniently placed, according to the order of lever to be applied.

In drawing all pickets, care should be taken that they are drawn out in the same line as that in which they have been driven, otherwise they are apt to be broken.

PILE DRIVER.

The only pile driver issued for artillery service is that known as the "*Swiss*;" it consists of a cylindrical block of oak, called the monkey, about 3 feet long and 9½ inches in diameter, having a hole running through its longer axis, so that it may be worked up
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and down on an iron rod, about two inches in diameter and six feet long, which is placed in a hole bored into the head of the pile or post to be driven.

The monkey is worked by means of iron handles attached to it; it is bound with an iron hoop at each end to prevent it from splitting.

The rod on which the monkey works should be in the continuation of the axis of the post to be driven, so that the monkey may give it the proper direction. Light guy lines attached to the head of the rod will prevent it lifting when the monkey is raised.

HOLDFASTS.

The most essential points to be considered before any heavy weight is moved or suspended, are, the nature and condition of the holdfasts required, together with the strain that will be brought on them.

The nature of the site of the holdfast should be considered, whether masonry, rock, clay, sandy or marshy soil, as each requires different treatment.

Existing holdfasts should not be trusted until carefully examined.

In forts or towers there is frequently much difficulty in finding holdfasts, those existing not being in the proper position. On sea fronts, there is also at times difficulty in laying down anchors.

Holdfasts can be made by placing baulks across embrasures or openings in masonry, in such cases an even bearing may be obtained, and the strain distributed over a large surface by placing planks for the baulks to bear against. Straps round piers of arches, or round guns already in battery, may also be used; in such cases all corners should be protected by wood, or the rope itself "*parcelled*" to prevent chafing or cutting, and the carriages or guns well scotched up.

When a composite holdfast is used, the strap should be so passed as to distribute the strain throughout the whole structure.

Ring bolts, let into masonry, should not be subjected to a greater strain than that for which they are intended.

In places where holdfasts can be driven or sunk, the ordinary picket posts can be made use of, but only when light weights have to be dealt with.

In *good* holding ground an ordinary three, two, and one 5-foot picket holdfast will stand a strain of *about* two tons.

In securing to a holdfast from which it may become necessary to ease off, at least one complete turn must be taken before making fast, otherwise when the strain is on it it is difficult to cast off.

The following holdfasts will be found useful and will serve as guides. Precise rules cannot be laid down as to the descrip-

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tion of holdfast to use for particular operations, but it should be remembered that it will save much time to make the holdfast, in the first instance, considerably more secure than absolutely required, as, when a holdfast once begins to give, it is difficult to strengthen it. Whatever holdfasts may be used the strain should be taken by the entire construction at once, as it might give in detail when it would not have done so as a whole.

1. Consists of a number of pickets driven into the ground (Fig. 146) parallel to each other, and in the line of prolongation of the strain at an angle opposite to which the strain is to come, this angle not being too great, the whole being lashed together.

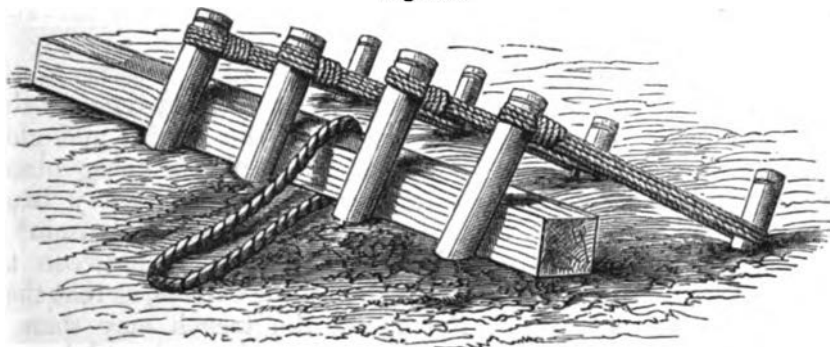
Fig. 146.



2. A good holdfast may be made by driving a row of heavy pickets, and another row about two or three feet immediately in rear of the first, then placing a heavy baulk against the first, and lashing the pickets in the two rows together (Fig. 147), care being taken that the baulk bears evenly against all the pickets in the first row.

A chain or strap is usually passed round the baulk to attach a rope or tackle to.

Fig. 147.



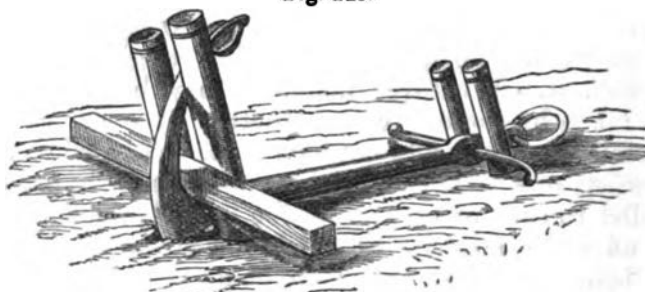
3. A heavy gun, sunk either vertically or horizontally, will also serve as a holdfast, the latter is the best, as in the former it only acts as a picket.

4. Anchors can be used as holdfasts, but they are troublesome to carry, and unless previously buried, *come home* before they hold.

To use an anchor as a holdfast (Fig. 148) bury one fluke, and place a baulk inside the crown at right angles, and drive pickets in front of the baulk; it may be further strengthened by driving pickets in front of the stock.

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Fig. 148.



Two anchors laid out as moorings form a good holdfast (Fig. 149).

For further details regarding anchor holdfasts see page 74.

Fig. 149.



5. The following holdfast (Figs. 150, 151) is suitable for very heavy weights.

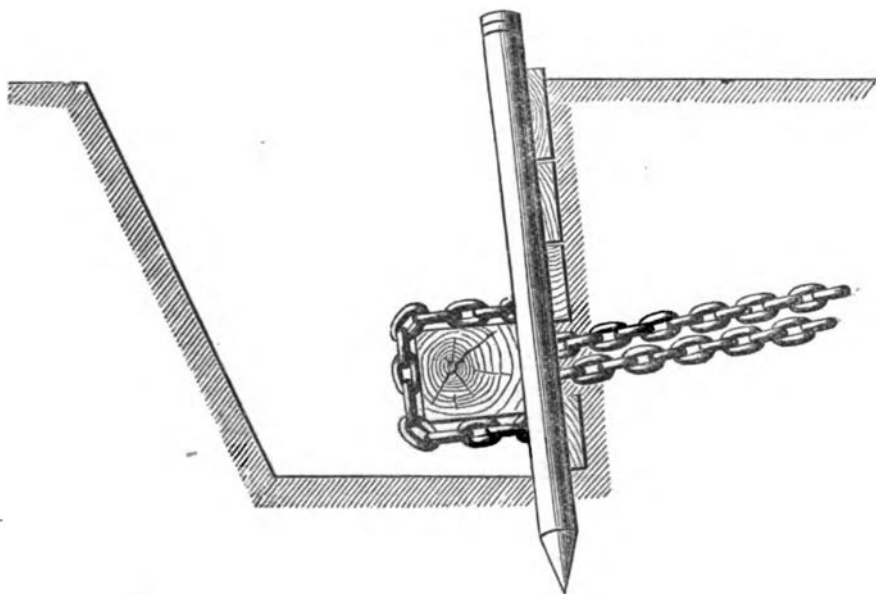
A trench about 4 feet deep is dug at right angles to the direction of the strain, four heavy pickets are then driven so that they will have an inclination opposite to the strain, and close enough to the side of the trench to admit of planks being placed against the side for the pickets to bear against. A heavy baulk with the double of a chain round it, is then laid on the bottom* of the trench, the ends of the chain being brought up between the planks along a trench, rising gradually to the surface, so that there will be no tendency to lift the baulk, the trench may then be filled in, if from the direction of the strain there should be any chance of the beam lifting.

6. Should it be necessary to construct a holdfast of this nature, when only a short baulk is procurable to pass the chain strap round, three or four large planks may be laid in front of the baulk Fig. 152. to distribute the pressure. In other respects the holdfast is constructed in the same manner as last described.

* The baulk in Fig. 150 has been shown a little above the bottom of the trench, to show the fitting of the chain.

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Fig. 150.

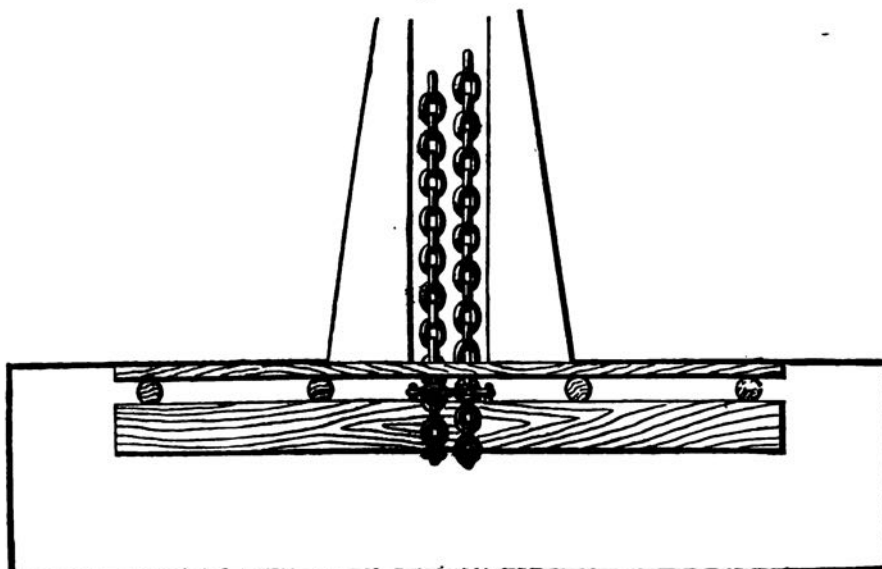


Holdfasts have sometimes to be constructed in rocky soils, where it is impossible to drive pickets or sink beams in the ground.

One of three cases of this nature will generally have to be dealt with

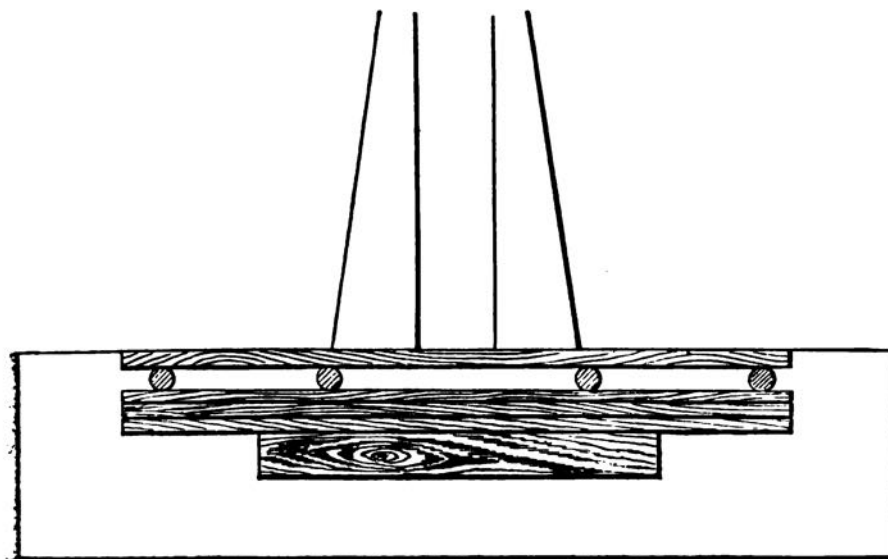
1. Where soft but sound rock, such as is often met with at Malta, forms the site: in this case a very good holdfast may be made by

Fig. 151.



Material and Appliances.

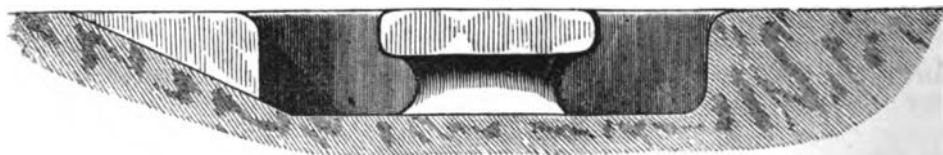
Fig. 152.



cutting a bollard (Fig. 153) round which the rope or chain strap of the tackle to be used is passed.

The size of the bollard should be regulated by the strain to be taken.

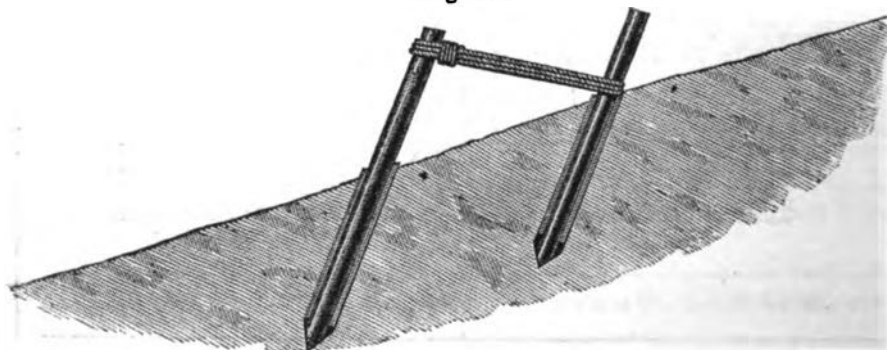
Fig. 153.



2. When a holdfast has to be made in very hard and sound rock, a good plan is to "jump" holes in it for the insertion of stout iron bars, say 2 or 2½ in. in diameter.

The bars are secured in the holes by slips of oak, the head of the first bar being lashed back to the foot of the second (Fig. 154).

Fig. 154.

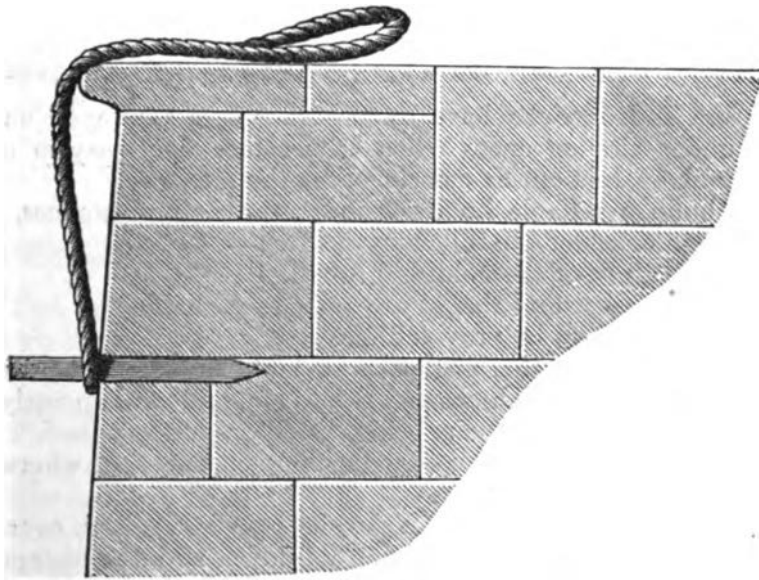


Material and Appliances.

The number and size of the bars employed and the depth to which they are sunk in the rock, should be proportionate to the strain to be encountered.

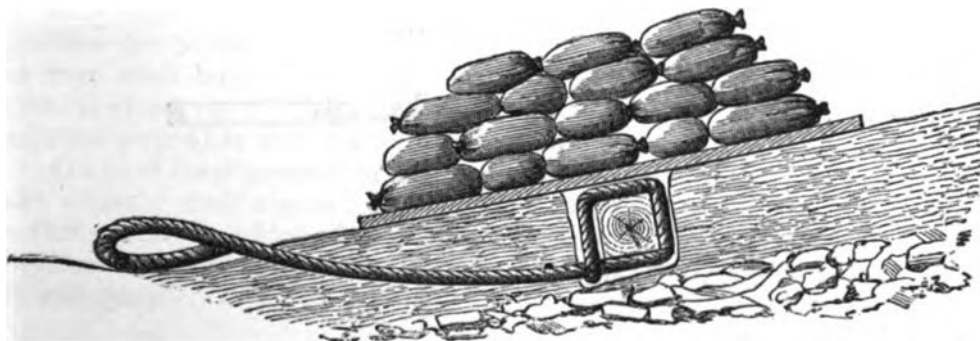
The holdfasts for foot tackles of sheers or derricks erected on the edge of a pier or escarp have sometimes to be made, as shown in Fig. 155.

Fig. 155.



¶ 3. When shallow soil overlies disintegrated rock, there may be insufficient holding ground for pickets, or for a sunken beam holdfast constructed in the usual manner, and the underlying rock although too shaly or split up to be treated as in cases (Fig. 153 and 154), may yet be too hard to admit of excavation; in this case the difficulty may be met by sinking a long and strong beam as far as practicable, say its own depth, in the surface soil (Fig. 156), and keeping it from rising by laying a platform of planks over it, and weighting it down with sand-bags, earth, rocks, or any available material.

Fig. 156.



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The beam, so long as it is kept from rising, will exhibit great holding power.

Rocky projections may be sometimes utilized for holdfasts by passing a chain round them, but they should be employed with caution, for the rock so used may be embedded but to a very small extent in the ground, and even in cases where the projection forms part of a large mass, it may only adhere to it through the medium of a weak shaly vein, and thus the portion made fast to may become detached under a comparatively small strain.

LAYING OUT ANCHORS AS MOORINGS FOR HOLDFASTS.

Sheers and derricks have sometimes to be employed on sea fronts under circumstances when it becomes necessary to make use of anchors, laid out as moorings, for the fore guy.

To obtain a reliable holdfast under these circumstances, it is necessary to consider the following points:—

1. The nature of the holding ground.
2. The number and size of the anchors available.
3. The strains to be provided for.

The further out the anchors are laid, the more horizontal will the strain be which comes upon them, and consequently the less the probability of their being lifted from their bed. This should be borne in mind before deciding on the spot where the moorings are to be laid down.

The height of the head of the sheers, when raised, over the spot where the moorings are to be laid down, and the distance of the latter from their feet, will decide the angle of upward strain.

The requisite information regarding the nature of the holding-ground can generally be elicited by inquiries made on the spot.

As regards the size and number of the anchors to be employed, this will, of course, depend on the holding-ground, the strain to be provided for, and the upward angle along which it will act, but, as a rule, the largest anchors procurable should be used, provided means are at hand for laying them out.

The exact spot where each anchor is to be let go, should have been decided upon beforehand and buoyed.

To guard against anchors falling over on their side, and so failing to take hold, it is a good plan to take the precaution of lashing a 7-foot handspike, or 8-foot lever to the stock, as in Fig. 157.

Fig. 157.



Material and Appliances.

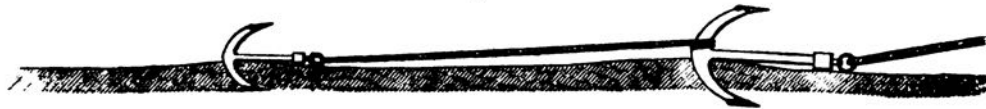
It is well to let a tide or two run over the anchors after being laid out, before putting a strain on them, in order to give them time to settle down.

All anchors should be buoyed. The buoy-line or rope should be attached to one of the flukes, and be of sufficient strength to extricate the anchor from the holding-ground, and lift it when required.

Tarred rope is most suitable for this purpose.

The holding power of an anchor is very greatly increased by laying out another anchor behind it as in Fig. 158, which shows a large or "stream" anchor, backed up by a small or "kedg" anchor, in the manner described.

Fig. 158.



Two large stream anchors laid out as in Fig. 149, and backed by two kedg anchors, will hold well.

Chain cables of sufficient strength are preferable to rope for making fast to anchors, especially where the ground is foul or rocky.

The shore end of the cable to which the fore guy of the sheers has to be attached should be buoyed until required.

The fore guy tackle will be at the head of the sheers.

A strain one and a half times as great as the *maximum* strain liable to be thrown on the anchors should be exerted on the moorings by means of winch power before they are taken into use; this will serve as a test, and make the anchors take hold; if after taking hold they cease to "come home," and hold well, they may fairly be relied on, yet inward heel with the sheers should be avoided, indeed it is rarely necessary.

If possible, the co-operation of the Naval Authorities should be secured in laying out moorings for heavy operations.

PORTABLE HOLDFASTS.

In moving heavy weights over long distances a portable holdfast will be found most useful, especially if constant change of direction is requisite; an ordinary wooden sling wagon carrying a 5-ton gun answers well for the purpose; the mode of employing it is as follows: The rear of the wagon is placed towards the position the capstan is to occupy, and the wheels are scotched up in rear with large scotches. A 14-foot skid is placed on the ground close up to the wagon body, wheels in front, and the capstan secured to the skid by a long strap or sling.

On hard level ground the holding power thus obtained is about the strain a crab capstan is capable of exerting, say 2 tons; on softer ground in which the wheels sink to a certain extent the holdfast will of course offer a far larger amount of resistance before it will move.

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SIMPLE MECHANICS, CONNECTED WITH MACHINES USED IN THE ARTILLERY SERVICE, STRENGTH OF MATERIAL, &c.

STRENGTH OF ROPE.

The question of the strength of ropes and their safe working load, under varying circumstances, being obviously of great importance, a series of practical experiments was carried out in 1873 in the Royal Arsenal at Woolwich by the Inspector of Machinery, from which the following facts were mainly deduced:—

1st. Italian hemp ropes are stronger than Russian in the proportion of—

Italian.	Russian.
100	From 79 to 93·4.

2nd. Russian hemp ropes are the least rigid in the proportion of—

Italian.	Russian.
100	From 80·4 to 96·5.

3rd. The deterioration of hempen ropes after a few months' wear, although still apparently good to careful examination with the eye was, with the best ropes, after six months in use, equal to a loss of 25 per cent., and extended, with other ropes, to a loss of 51 per cent., thus showing that it is imperative to employ a large margin of safety.

Rope stowed in damp stores, or ropes coiled down in masses when more or less wet or damp (especially with salt water), rapidly deteriorate and become quite untrustworthy. From the fact of its being often next to impossible, in damp climates, to thoroughly dry rope which has become saturated in use, the comparatively small strains at which seemingly good rope will, not unfrequently, part is easily accounted for, and points to the necessity for most careful supervision before taking rope into use in heavy operations. Even then the conclusions arrived at from the most careful inspection may be faulty, for, however good a rope may *appear* to be, it may be worm-eaten in the heart, or have undergone serious deterioration from a minute fungoid growth, due generally to its having heated when stowed away damp. When such is the case the interior of the rope will have a slaty-grey appearance; therefore, unless working with absolutely new rope, it is well to apply, by means of winch power, the test of a strain equal, or as nearly so as possible, to that to which the rope will probably be subjected in the operation about to be undertaken. Such a precaution would not be necessary where the tackles are merely to be employed in drawing heavy weights along the level, but would be advisable with doubtful rope in cases where such operations as hauling heavy guns up steep slopes, or

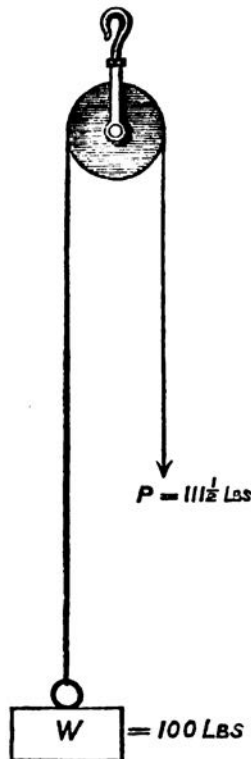
Material and Appliances.

unshipping by means of sheers from vessels, have to be undertaken, and when the parting of a fall would probably be attended with serious consequences.

4th. When rope is rove through the sheaves of blocks to form a tackle, the fact of having to overcome the friction of the sheaves in the blocks, and the stiffness or rigidity of the rope, where it has to be bent into a sharp curve at each return, to follow the circumference of the sheave, detracts largely from the *theoretical* power of the tackle. The average additional force required to be exerted on the running end of a fall to raise or impart motion to a weight was found to be $11\cdot4$ or $11\frac{1}{2}$ per cent. of the weight for every sheave in use.

Example.—One sheave in use.

Fig. 159.



When it is considered that so large an allowance as $11\cdot4$ per cent. has to be made for each sheave in use, under the most favourable circumstances, *i.e.*, service blocks, in the best condition, perfectly fair lead for the fall and clean and well-lubricated blocks, it must be obvious that under ordinary service conditions 12 per cent., or say one-eighth of the weight raised, would be the *smallest* allowance per sheave that could reasonably be made, for the slightest twist destroys the trueness of the lead, and ropes after being dragged about the ground are continually shedding grit and dirt on the shell of the block and sheave pin, thereby vitiating the

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good effects of lubrication. And, indeed, it is but seldom that time or opportunity is afforded for having the blocks taken to pieces and cleaned and lubricated before commencing work.

The Inspector of Machinery lays down that, if ropes are only to be worked to $\frac{1}{6}$ of their ultimate or breaking strain (which he considers is the limit up to which rope, under ordinary working conditions, should be worked), an allowance of only 10 per cent. for friction and stiffness of ropes, for every sheave in use is admissible. It is a handy figure to work with, and sufficiently true, as regards the results obtained, so long as such a large margin of safety is allowed; but by the present service rules for calculating the safe working strain of ropes, they are worked up to about $\frac{1}{3}$ to $\frac{1}{2}$ of their breaking weight *when new*, and so long as such rules are in force, it is better and safer that the larger allowance of $\frac{1}{6}$ th the weight raised, should be added for every sheave in use, for friction and stiffness of ropes, in calculating the total resistance to be overcome, for by so doing a fairly true approximation will be arrived at, instead of a result very considerably below the actual resistance to be overcome.

Example.—A 12-ton gun has to be raised by sheers, the main tackle of which consists of two 15-inch treble Bothway blocks rove with a fall of 5-inch white rope led through a snatch block at one foot. Calculate the strain required to be exerted at the winch on the running end of the fall.

The theoretical power of the tackle being 6 to 1, the power, P, required to be exerted, will be $\frac{1}{6}$ of R, the total resistance to be overcome, which is compounded of W, the weight to be raised plus the resistance arising from friction and stiffness of rope. There are 7 sheaves in use.

Then adding $\frac{1}{8}$ W for each sheave, we get

$$R = W + \frac{7}{8}W = \frac{15}{8}W$$

$$\text{and } \frac{R}{6} = P$$

$$\therefore P = \frac{\frac{15}{8}W}{6}$$

$$6P = \frac{15}{8}W = \frac{15 \times 12}{8}$$

$$\therefore P = \frac{45}{12} = 3\frac{3}{4} \text{ tons.}^* \dagger$$

* Weight of aling and lower block not included in this calculation.

† Strictly speaking the strain on the running end of the tackle should be first calculated, and the allowance for friction from the rope being led through a leading block added afterwards.

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Now applying the service rule for calculating the safe working strain of *new* 5-inch rope, we have $\frac{5^2}{7} = \frac{25}{7} = 3\frac{4}{7}$ tons, or rather *less* than the strain to which the rope would be subjected; showing that it would be advisable to use a 6-inch fall for such an operation, especially if only *worn* rope was available.

Another Example.—What weight can be raised by a tackle consisting of two treble 18-inch Bothway blocks rove with a fall of 6-inch worn rope, without exceeding the service working strain, the fall being led through a snatch block?

The circumference squared, divided by 8, gives $4\frac{1}{2}$ tons as the maximum working strain, the power, P , to be applied at the running end of the fall, must not therefore exceed this; then using the same formula as before:—

$$\begin{aligned} P &= 4\frac{1}{2} \text{ tons.} \\ 6 P &= 27 \text{ tons.} \\ \text{but } 6 P &= R = W + \frac{7}{8} W = \frac{15 W}{8} \\ \frac{15 W}{8} &= 27 \text{ tons.} \\ \therefore W &= 14\frac{2}{3} \text{ tons.} \end{aligned}$$

The weight to be raised should therefore not be more than $14\frac{2}{3}$ tons.

Hence it will be seen that a 25-ton gun is the heaviest gun at present in the service that should be raised by means of two main tackles of this nature.

If the working parts of blocks are not properly lubricated, the power required to work the tackle is thereby increased 27 per cent.

If the blocks are not maintained in their proper working position, but are allowed to twist, and thereby cause the ropes to rub upon each other in working, the power required to work the tackle is greatly increased, so much so, that if one of the blocks is allowed to twist through one complete turn, the power required will be increased 42 per cent.

In each of these two latter cases, not only is the power required to work the tackles increased, but of course the strain upon the ropes is increased in the same proportion, and the margin of safety thereby diminished.

UNCOILING AND STRETCHING ROPE.

It being difficult to uncoil a coil of new rope without getting it full of kinks, the following plans have been devised to meet the difficulty.

1. Place the coil on a ground roller, or picket (put through the centre), which should rest between the upper spokes of two hand,

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or trench carts, placed parallel to one another, a second roller, or picket, being inserted through the coil and the two lower spokes; both should be lashed, and the carts be raised off the ground so that the wheels are free to revolve.

The two carts, which should be at such a distance apart that both ends of the coil may receive support from the spokes of the wheels, are secured to holdfasts.

On the wheels being caused to revolve, the running end from the outside of the coil can be walked away with.

If the coil is a small one there will not be room for a second picket, in which case one or two returns of strong lashing may be used instead.

2. Place a ground roller through the centre of the coil, support the ends of the roller sufficiently high to keep the coil off the ground, and then run away with the end of the rope on the outside of the coil, which will revolve on the roller, and so leave the rope free to run.

3. Another method is to place a 5-foot picket through a mortice hole in the head of a crab capstan windlass, lift the coil, put it on top, and then proceed as before described.

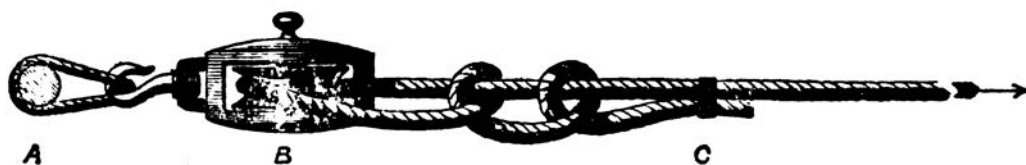
The picket should be used to help the windlass to revolve, and the coil be steadied by hand.

It is most essential that ropes which are to be used for reeving tackles should be well stretched first, or the blocks will have a very strong tendency to twist. The greater the strain the greater the tendency of the rope to "unlay" itself and so cause twist; it therefore follows, that to stretch a rope properly before use, it should be subjected to the same strain in the stretching that it will have to undergo in working.

In order to do this, it is requisite to lay the rope out its full length, 113 fathoms, along the ground, connect one end with the barrel of a crab winch, of the same power that it is intended to make use of in the operation about to be carried out, and make fast the other end to a holdfast in the following manner.

Suppose A to represent the holdfast, and B an 18-inch single swivel hook block secured to it, then the rope being passed

Fig. 160.



over the sheave of the block, is made fast to itself with two half hitches round the standing end at C.

As soon as the winch is worked and the rope made taut, it will

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begin to unlay, and spin the block B round, thus taking the twist out of the rope; and this will go on, until the maximum strain required, say $3\frac{1}{2}$ tons, has been worked up to, when it may be left taut for an hour or so and then coiled down. One manifest advantage of this plan is, that the rope is tested as well as stretched.

The longer a tackle is, the more apt it is to become twisted, in many cases it is practicable to rig anti-twisters, by lashing a 7-foot handspike with spun yarn securely to the shackle of the block, and fitting long light lines to each extremity of the handspike to make fast with, or hold on to, and so prevent the block from turning. In the case, however, of the main tackles of sheers this plan cannot be adopted with the upper blocks, as they must be left clear to swing to front or rear (as the sheers are heeled) between the spars in the contracted space just below the head of the sheers; however, an excellent plan to guard against these, or, indeed, any long tackles, from twisting, is to reeve the fall so that the running end comes off from a centre sheave; two of the returns, on the same side, must, it is true, cross, but, as they are travelling the same way, (though at unequal rates) it will be found to be practically of no importance, and the gain in avoiding twist is inestimable.

Ropes used with thimbles are safer than when ropes are slung over hooks, or when fastened by knots, even to the extent of 28 per cent. Therefore rope slings or straps should always be so fitted if they may have to take a great strain.

The hook of a block, even if it should not cause a sling to part, will soon destroy it (under great pressure) by cutting into the strands.

All who have had large practical experience with rope, even of the best qualities, have arrived at the conclusion that the life of ropes in constant hard work is so uncertain, and they are found untrustworthy so unexpectedly, that no precaution should be neglected to ascertain by careful inspection (and actual test in doubtful cases) their working value before undertaking any heavy operation in which rope tackles have to be employed.

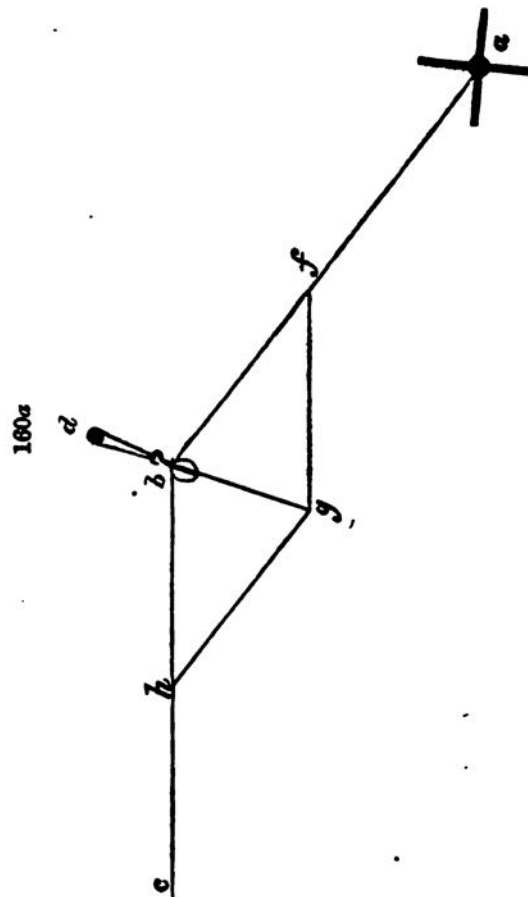
The actual strains to which they may be subjected should be calculated beforehand. And it should always be borne in mind that it is better to err *on the safe side*, and have a margin of safety in your favour.

All tackles at present in use in the Artillery service for sheers, gins, &c., being rope tackles (the only exceptions being the chain tackles of permanent sheers and cranes) it will not be necessary to enter into a comparison of the relative merits of rope and chain for lifting tackle. The mode of calculating the safe working load of chain is laid down at p. 405.

To find by construction the strain on the strap or lashing securing a leading block. In this case the angle abc is 145° , and the scale for strains is 2 tons to an inch.

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Let "a," (Fig. 160a), represent a capstan, exerting a strain of two tons on a rope passing through a leading block "b," to an object at "c."



Set off " $b f$," " $b h$ " each representing 2 tons, complete the parallelogram $b f g h$, and join $b g$. The strain on the strap or lashing at d is represented by the diagonal $b g$, the resultant of the two forces $b f$ and $b h$, and is in this case equal to $1\frac{1}{2}$ tons.

As the angle $a b c$ decreases the strain on the leading block increases, and vice versa.

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The strain reaches its maximum when the angle $a b c$ is 0° , (Fig. 160b), in other words when the return $b c$ leads back parallel to $a b$, in which case it would be double that exerted by the capstan or 4 tons; friction is not taken into account in the foregoing.

THEORETICAL POWER OF MACHINES, DISREGARDING FRICTION.

All instruction of N.C. officers and men in the power of the various machines they have to use should be as simple as possible, in order to be easily understood. With a view to this simplicity the following may be found useful.

LEVERS.

The first two only of the three orders of levers are, as a rule, used in the Artillery service. Fig. 166, 1st order; fig 167, 2nd order.

Fig. 166.

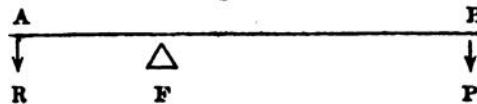
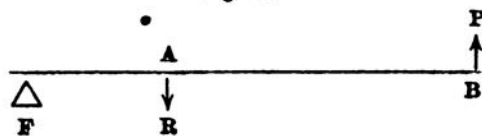


Fig. 167.



Both consist of two parts; the lever, which we will call L , is the length between B , where the power P acts, and the fulcrum F . The counter-lever CL is the length between A , where the resistance R acts, and the fulcrum F .

Then in all cases

$$P : R :: CL : L.$$

And to find any of them

$$P = \frac{R \times CL}{L}$$

$$R = \frac{P \times L}{CL}$$

$$CL = \frac{P \times L}{R}$$

$$L = \frac{R \times CL}{P}$$

Bent levers may however be used, or the power or resistance may not be applied parallel to each other in direction or at right angles to the lever. Figs. 168, 169, and 170.

(A. M.)

2 E 2

Material and Appliances.

Fig. 168.

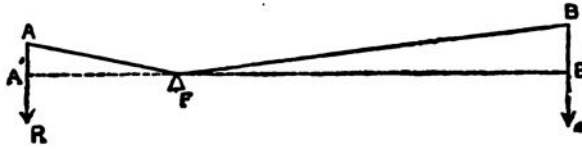


Fig. 169.

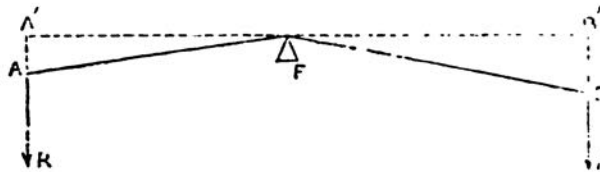
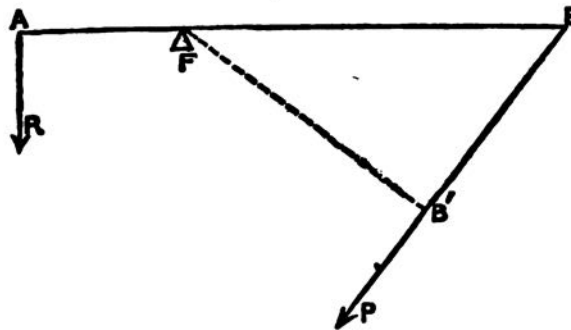


Fig. 170.

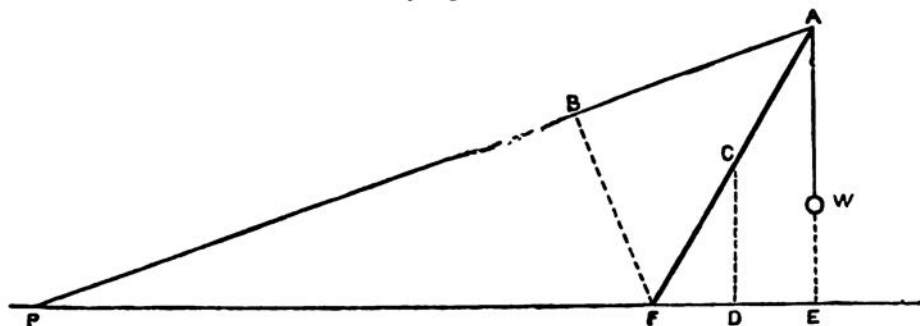


Then perpendiculars let fall from the fulcrum on the direction of the power and resistance must be taken as the lever and counter-lever. In the cases shown in Figs. 168, 169, and 170 FB' will be the effective lever, instead of FB , and in Figs. 168 and 169 FA' the counter-lever instead of FA .

SHEERS and DERRICKS.

Sheers may be regarded as bent levers of the 1st order.

Fig. 171.



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F = Foot of the sheers.

AP = Back guy.

W = Weight of main fall + Weight of gun + sling, &c.

AF = Spars.

C = Point where weight of spars acts at centre of gravity.

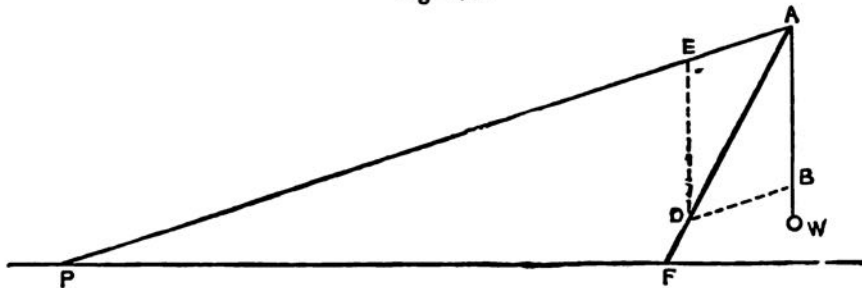
Draw FB perpendicular to AP; CD and AE perpendicular to PE.

Then

Tension of guy \times FB = W \times FE + Weight of spars \times FD.
From this equation the tension of guy may be found.

Another method is the following :—

Fig. 172.



Let AF = Length of spars.

AP = Length of back guy.

PF = Distance of back guy from foot.

AW = Direction of weight.

W = Weight of gun.

Make AB = W + weight of main fall + $\frac{1}{2}$ weight of spars.

Draw BD parallel to AP and complete parallelogram ABDE.

Then AB = Weight.

EA = Strain on back guy.

AD = Thrust on spars.

WHEEL AND AXLE.

In the wheel and axle $P : R :: \text{Radius of axle} : \text{Radius of wheel}.$

The bars of a crab capstan represent the wheel, the radius of the barrel + the semi-diameter of the rope the axle.

Mean diam. of windlass	= 10 inches
„ diam. of rope	= 1 inch (about)
Length of capstan bar	= 16 ft.
Do. do. effective	= 12 ft.
Do. of leverage	= 6 ft.

Then

$$P : R :: 5\frac{1}{2} \text{ in.} : 6 \text{ ft.}$$

$$P : R :: 1 : 13 \text{ nearly.}$$

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TRIANGLE GYN.

*Diameter of rope . . . 1" (about)
 „ barrel of windlass 8" „
 Effective leverage . . . 7' 5" „
 $P : R :: 4\frac{1}{2}'' : 7' 5'' :: 1 : 19.77$
 Due to Tackle 1 : 6
 $P : R. 1 : 118.62$

SLING WAGON.

Data same as for triangle gyn.

Excepting { Diameter of sling = 2"
 { Power gained by sling = 2 : 1
 $P : R :: 5'' : 7' 5'' :: 1 : 17.8$
 Due to sling, 1 : 2
 $P : R :: 1 : 35.6$

TOOTHED WHEELS.

$P : R ::$ No. of teeth in small wheel : No. in large.

WINCH.

Radius of handle = 1' 2" } including half diameter of rope.
 Do. of barrel = 0' 4 $\frac{1}{2}$ " }
 Number of teeth.
 Small wheel on driving shaft = 12
 Large „ spindle = 36
 Small „ „ = 12
 Large „ barrel = 72
 $4\frac{1}{2} : 14$
 $P : R :: 12 : 36'$
 $12 : 72'$
 or 1 : 56

N.B.—Other winches in the Service give a different mechanical advantage.

GIBRALTAR GYN.

Radius of handle = 13"
 „ windlass = 3"
 Diameter of fall = 1"
 $P : R :: 3\frac{1}{2}'' : 13'' :: 1 : 3.714$
 Due to tackle, 1 : 6
 Due to toothed wheels, 11 : 57
 $P : R :: 1 : 115.47$

* For an 18-foot light gyn, the fall being 4 inches in circumference.

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WHEEL PURCHASE.

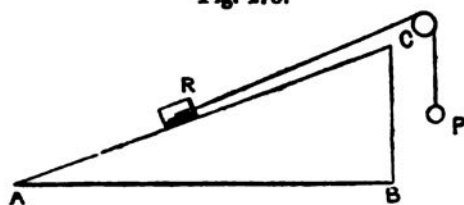
$$P : R :: 1 : 2$$

PARBUCKLING.

$$P : R :: 1 : 2$$

INCLINED PLANE.

Fig. 173.



$$P : R :: \text{The height : Upper surface}$$

$$P : R :: CB : AC$$

A scotch is an example of an inclined plane, and depends for its efficient action under ordinary circumstances on the angle at which its upper surface is inclined, and the friction between its base and the substance on which it is placed.

MOVEABLE INCLINED PLANE.

$$P : R :: \text{The height : The base (using fig. 173)}$$

$$P : R :: BC : AB$$

In the elevating gear of the 7-pr. mountain gun an inclined plane worked by a screw is used, the base of which is 7.5 inches, its height 5 inches. In this case the power gained by the plane is as 7.5 : 5 nearly, or 3 : 2.

WEDGE.

The usual form of wedge is that of two inclined planes connected base to base. Therefore

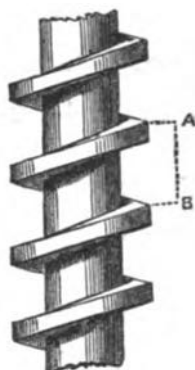
$$P : R :: \text{Half the back of the wedge : The length}$$

The immense friction in the case of wedges, and the power used being generally percussion and not pressure, makes their theory not applicable in practice with any degree of accuracy. In general terms the wedge is more powerful as its angle is more acute.

SCREW.

In the screw the distance between the corresponding surfaces of two contiguous threads is called the distance between the threads.

Material and Appliances.



AB = distance between threads of screw.

$P : R ::$ Distance between the threads : Circumference described by motive power.

LIFTING JACK (Clerk's).

Length of handle = 3' 4"

Distance between threads = $\frac{1}{2}$ "

$P : R :: \frac{1}{2}'' : 3' 4'' \times 2 \times 3.1416,$
or $1 : 502.656$

ELEVATING SCREW.

Length of handle . . . = 2' 1"

Distance between threads = $\frac{1}{2}$ "

$P : R :: \frac{1}{2}'' : 2' 1'' \times 2 \times 3.1416,$

or $P : R :: 1 : 314.16.$

ENDLESS SCREW.

When an endless screw works on a toothed wheel each revolution of the screw turns one tooth of the wheel to which it is attached.

Therefore $P : R :: 1 : \text{No. of teeth in the wheel}$

$::$ Distance between threads : Circumference described by the motive power.

HYDRAULIC JACK.

The hydraulic jack consists of a small piston worked by a lever, transmitting pressure through water to a larger piston; the pressure is therefore equal in every direction, and that on the surface of the larger piston will be as its area to that of the smaller, and these areas are to each other as the squares of their diameters.

Material and Appliances.

Therefore $P : R :: \begin{cases} \text{Length of counter-lever : lever} \\ \text{diameter}^2 \text{ of small piston : diameter}^2 \text{ of large} \end{cases}$

In one of the jacks used in the service

Diam. of small piston = 0.75"

large " = 2.5"

Effective length of lever = 22"

Counter-lever = 1.5"

$$P : R :: \begin{cases} 1.5 : 22 = 1 : 14.66 \\ .75^2 : 2.5^2 = 1 : 11.1 \end{cases}$$

$$:: 1 : 162.95 \text{ nearly}$$

ROLLERS.

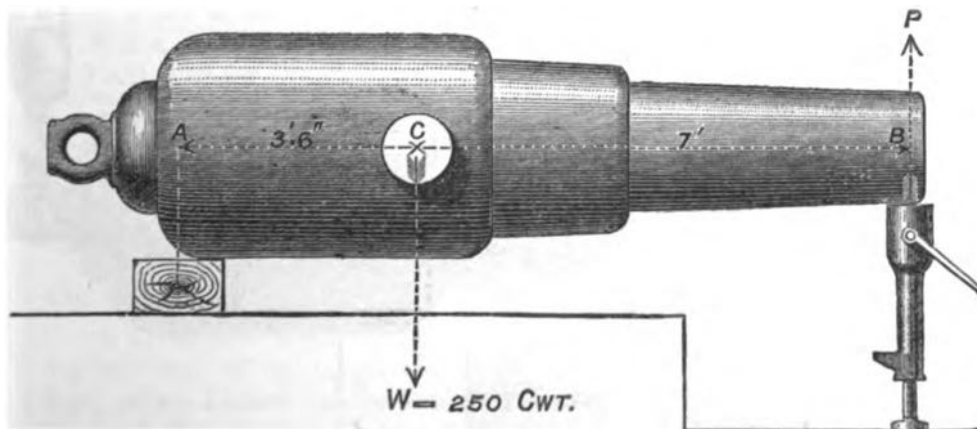
Rollers give no mechanical advantage, but decrease friction only. They travel at half the rate of the body which rests upon them.

CALCULATION OF THE DISTRIBUTION OF WEIGHT OR PRESSURE OF A GUN WHEN SUPPORTED ON SKIDDING.

When a gun is skidded, and it is desirable to ascertain the weight or pressure on each skid, the following plan is adopted:—

The gun itself is treated as a lever of the second order, the power acting at one skid, whilst the other forms the fulcrum, the weight acting at the centre of gravity between the two skids.

Fig. 161.



Example.—A 12½-ton gun is supported on a hydraulic jack at the muzzle, 7 feet in front of the centre of gravity, and on a skid, under the breech coil, 3 feet 6 inches in rear of the same (vide Fig. 161), calculate the pressure at each point of support.

Material and Appliances.

Now in this case W , the weight = $12\frac{1}{2}$ tons, or 250 cwt.

To find the pressure on the jack.

The counter lever, is $A C = 3.5$ feet

The lever, is $A B = 10.5$ feet

Applying the formula for the lever we get

$$P : W :: C L : L$$

$$P : 250 :: 3.5 : 10.5$$

$$10.5 P = 250 \times 3.5 = 875$$

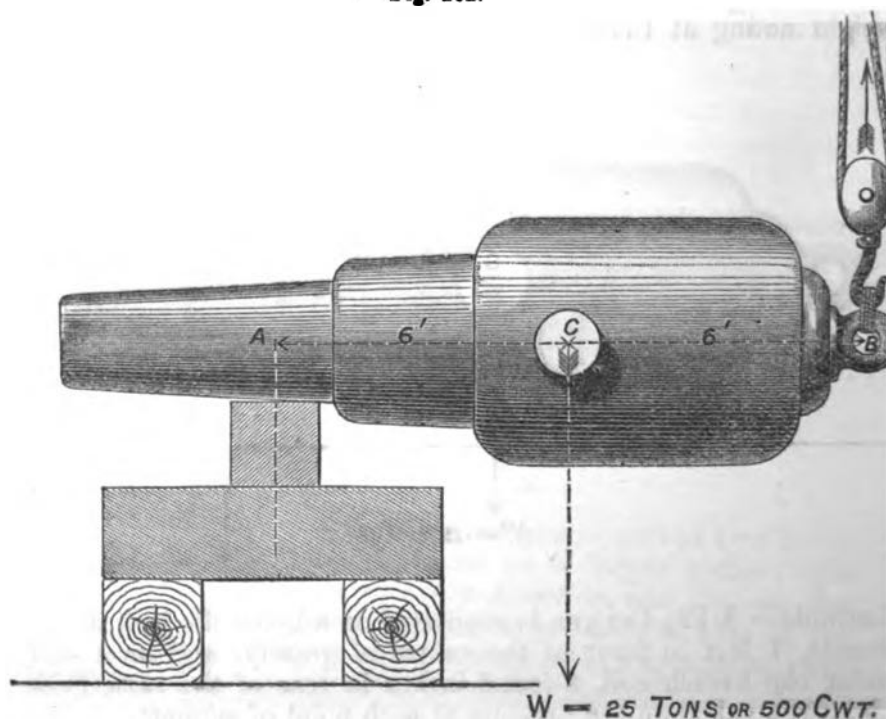
$$\therefore P = \frac{875}{10.5} = 83.3 \text{ cwt., or 4 tons 3.3 cwt.}$$

which is the weight on the jack.

The pressure on the breech skid must therefore be 166.7 cwt., or 8 tons 6.7 cwt.

Another example:—Assuming the distance from the centre of gravity (which, with all the heavier natures of guns may be taken to lie in the axis of the trunnions) to the point of suspension at the cascable of a 25-ton gun to be 6 feet, how far in front of the centre of gravity must the gun be skidded to throw a weight of $12\frac{1}{2}$ tons on the tackle of an 18-ft. heavy gyn employed to raise the breech? (Fig. 162.)

Fig. 162.



Material and Appliances.

Applying the same formula as before, we get (when the counter lever is A C, and the lever A B = A C + 6')

$$\begin{aligned} P : W &:: C L : L \\ 250 : 500 &:: A C : A C + 6' \\ 250 (A C + 6) &= 500 A C \\ A C + 6 &= 2 A C \\ \therefore A C &= 6 \end{aligned}$$

The gun must therefore be skidded at the "half-weight" mark A.

A simple case of this sort would be evident without any calculation. The figures are simply given to show the mode of procedure, which is precisely the same in every case.

CALCULATION OF CROSS-BREAKING STRAIN OF TIMBER.

It being but seldom that other than fir and oak skids are used in the Artillery Service, it will be sufficient to consider these two natures; and, in all but exceptional cases, the only *breaking* weight that has to be calculated is that when the beam or skid is supported at both ends and loaded in the middle. The formula for which is

$$W = \frac{4 b d^3 S}{l}$$

Where W is the breaking weight in pounds, *l* the distance between points of support, *b* is the breadth or horizontal measurement, *d* is the depth or vertical measurement of a section of the beam when in use, all given in inches.

S is a co-efficient whose value for service fir skids may be taken at 1100, and for oak skids at 1977.

The *safe working load* for selected timber may be taken as $\frac{1}{2}$ W, and for unselected timber as $\frac{1}{4}$ W.

Should the co-efficient S be required for other natures of timber, information on the subject will be found in the Handbook for Field Service.

The following examples will show the practical application of the formula:—

A fir skid 6' × 12" × 12" is lying across a platform supported for one foot of its length at each end, what is its safe working load, when loaded in the middle, assuming it to be unselected timber? the distance between the points of support being 4 feet.

By the foregoing rules $\frac{W}{4}$ or the safe working load is—

$$\frac{b d^3 S}{l} \quad \text{Where } b = 12'' \quad d = 12'' \quad S = 1100 \\ l = 4 \text{ ft.} = 48 \text{ inches.}$$

Material and Appliances.

$$\frac{b d^3 S}{l} = \frac{12 \times 12 \times 12 \times 1,100}{48} = 39,600 \text{ lbs.} = 17.66 \text{ tons.}$$

A beam of oak, selected timber, $10' \times 15'' \times 9''$, used on its edge, is supported for one foot of its length at each end, and loaded in the middle. What is the safe working load? In this case the

$$\text{safe working load} = \frac{W}{2} = \frac{2 b d^3 S}{l}.$$

Where $b = 9''$ $d = 15''$ $S = 1977$ $l = 8 \text{ ft. or } 96 \text{ inches.}$

$$\frac{2 b d^3 S}{l} = \frac{2 \times 9 \times 15 \times 15 \times 1977}{96} = 83,405 \text{ lbs. nearly}$$

$$= 37.2 \text{ tons.}$$

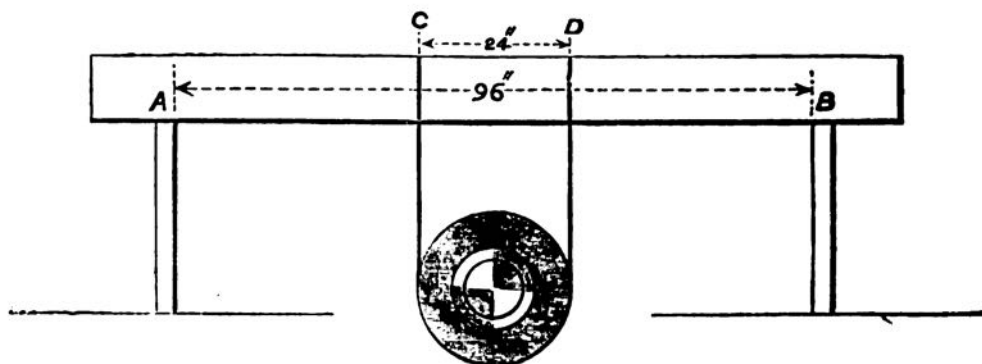
The third case to be considered is when a certain space $C D$ (vide Fig. 163) is included between the lashing supporting the weight. In this instance the interval $C D$ must be deducted from the length between the points of support A and B . Taking the same beam, with the same distance between A and B , viz., 96 inches, we have $l = A B - C D$. Let $C D$ equal 2 feet or 24 inches, and our data will be as follows:—

$$b = 9'' \quad d = 15'' \quad S = 1977 \quad l = 96 - 24 = 72 \text{ inches.}$$

$$\text{Then } \frac{2 b d^3 S}{l} = \frac{2 \times 9 \times 15 \times 15 \times 1977}{72} = 111,206 \frac{1}{4} \text{ lbs.}$$

$$= 49.6 \text{ tons nearly.}$$

Fig. 163.



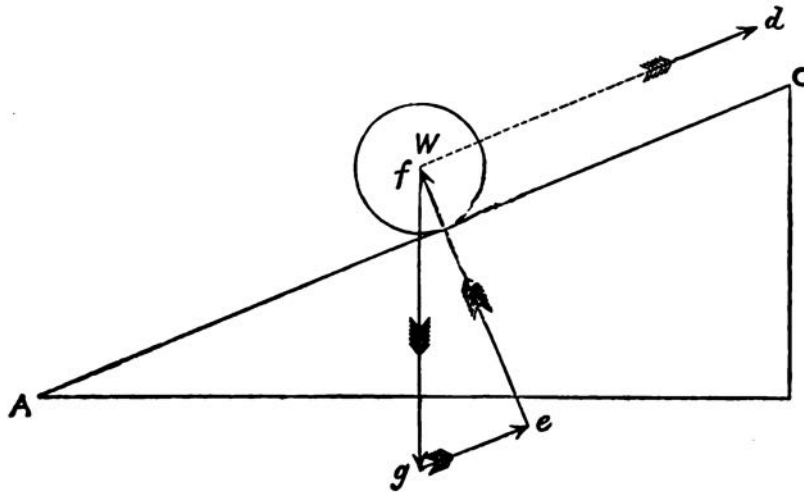
FINDING PRESSURE OF WEIGHTS ON INCLINED PLANES.

Let a certain weight W be resting on an inclined plane $A C$, and held there by tractive power, acting in the direction $f d$, parallel to $A C$, the force of gravity acting along the vertical $f g$,

Material and Appliances.

and the reaction of the plane (or its resistance to bending or breaking) acting on the line $f e$, perpendicular to $A C$.

Fig. 164.



These three forces acting on the weight are in the same proportion as the sides of the triangle $e f g$, where

$g e$, represents the tractive power

$f g$ the force of gravity

and $e f$ the reaction of the plane.

Example.—An 18-ton gun is resting on short skidding on the deck of a barge, the pressures on the breech and muzzle skids being respectively 12 and 6 tons. Find by construction what the pressure on the breech skid will be, when parbuckling the gun up out of the barge on to a wharf when the skids have a slope of $\frac{1}{2}$, and occupy the same relative positions, with reference to the centre of gravity of the gun as the short skidding described above. Friction being neglected, and it being assumed that the two parbuckle ropes are parallel to the long skids.

Here we have $a c$, representing the weight, 12 tons,
 " $a b$, " the pressure
 on the breech skid, and $c b$ the total strain on the two returns of
 the parbuckle rope; referring these to the scale, we find their
 values to be

$$a c = 12 \text{ tons}$$

$$a b = \text{rather more than } 10\frac{1}{2} \text{ tons}$$

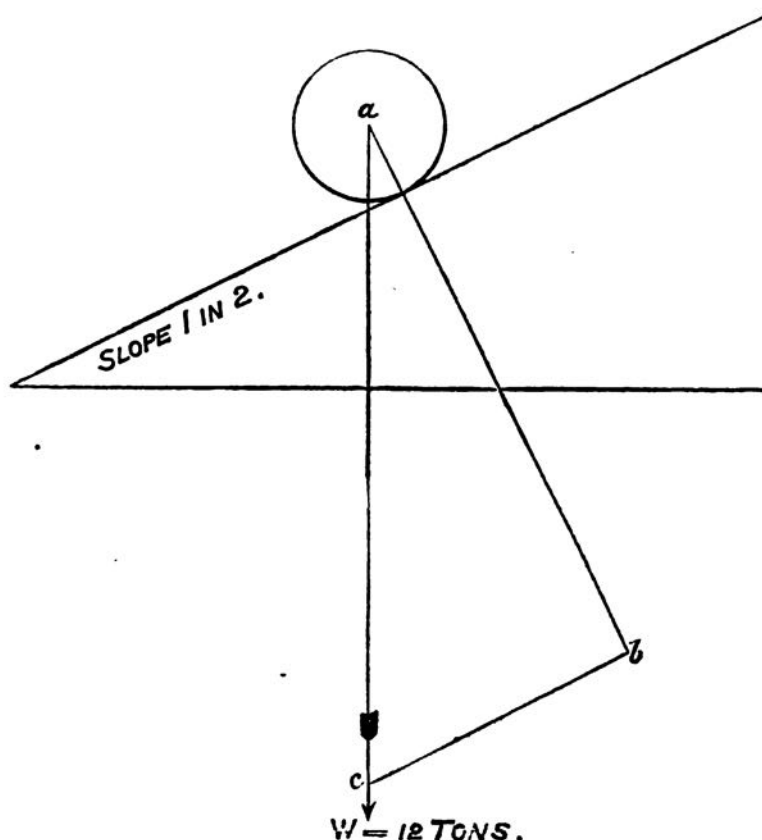
$$c b = 5 \text{ tons } 8 \text{ cwt.}$$

N.B.— $\frac{1}{2} c b$ or 2 tons 14 cwt. will be the "theoretical" strain on the running end of the parbuckle rope,

Material and Appliances.

Fig. 165.

(SCALE OF WEIGHTS AND PRESSURES: 4 TONS TO AN INCH.)



CALCULATION OF WEIGHT OF SHEER SPARS, &C.

To find the weight of spars, beams, &c., their cubical content is first calculated, in the manner explained below, and then multiplied by the weight per cubic foot, which may be ascertained by referring to the table of weights and specific gravities of timber, &c., given at page 441.

The specific gravity of any substance is the proportion the weight of a cubic foot of it bears to the weight of a cubic foot of fresh water. Now, a cubic foot of fresh water weighs 1,000 ounces or 62½ lbs., its specific gravity is termed 1·0, and to this standard all specific gravities refer. For example, suppose on referring to a table of specific gravities you find the S.G. of Dantzic pine to be ·65; then to ascertain the weight of a cubic foot, you have only to multiply the S.G. (·65 in this case) by 1,000 for the weight in ounces

$$·65 \times 1,000 = 650 \text{ oz.} = 40 \text{ lbs. } 10 \text{ oz.}$$

Material and Appliances.

The same mode of procedure holds good in every case.

To find the weight of a beam rectangular in section.

First calculate the number of square feet or inches contained in the end, by multiplying the sides together, then multiply the result by the length in feet or inches, and you will obtain the cubical content expressed in cubic feet or inches. To obtain the weight multiply the content in cubic feet by the weight per cubic foot.

Example.—Required the weight of a fir skid (Dantzic pine) $6' \times 12'' \times 12''$.

In this case both sides of the end being 1 foot in length it is plain that the area of the section is 1 square foot, this being multiplied by 6 gives 6 cubic feet as the cubical content of the skid.

A reference to the table of weights and specific gravities of timber, page 441, shows that one cubic foot of Dantzic pine weighs 40 lbs. (nearly);

$$6 \times 40 = 240 \text{ lbs.} = 2 \text{ cwt. } 16 \text{ lbs.}$$

Another example.—Required the weight of an oak beam $10' \times 15'' \times 9''$.

The area of the section is in this case 15×9 square inches = 135 square inches; $10' = 120''$; $135 \times 120 = 16,200$ cubic inches. To obtain the result expressed in cubic feet we must divide this by 1,728 (the number of cubic inches contained in one cubic foot).

$$\frac{16,200}{1,728} = 9.4 \text{ cubic feet nearly.}$$

Now, since a cubic foot of English oak weighs 48 lbs., the weight of the beam will be

$$9.4 \times 48 = 451.2 \text{ lbs.} = 4 \text{ cwt. } 3 \text{ lbs.}$$

To find the weight of a spar circular in section.

Two cases have to be considered, namely:

1. When the spar is of the same diameter throughout or truly cylindrical in form.
2. When the spar tapers from butt to tip or tapers from some point in its length towards both ends.

The method is the same in principle as that laid down for beams or skids of rectangular section, i.e., the area of the mean section having been found, the result is multiplied by the length for the cubical content.

The formula for ascertaining the area of a circle is πr^2 , where $\pi = 3.1416$ (or $3\frac{1}{7}$ expressed in fractions) and r is the length of the radius of the circle, where the mean section of the spar is taken.

The value of π (the relative proportion the circumference of a circle bears to the diameter when the latter is 1) being constant, it is only necessary to find r .

Material and Appliances.

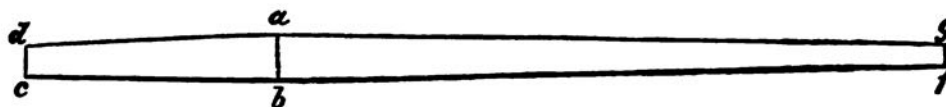
The circumference of a circle is usually designated by the formula $2\pi r$. In order therefore to obtain the value of r , measure the circumference and divide the result by 2π or 6.3. In case 2, supposing the spar to taper regularly from butt to tip, the measurement of the circumference should be made in the middle of the spar for the *mean* circumference, which, divided by 6.3, would give the mean radius.

Again, should the spar be thickest in the middle and taper thence to both ends, the measurement should be taken midway between the centre and one of the ends.

But should the greatest diameter of the spar lie somewhere between the middle and the butt, the simplest plan would be to calculate the weight as for two taper spars and add the results together.

Fig. 174 represents a spar of such a shape, $a b$ being the point where the diameter is greatest.

Fig. 174.



To find the total cubical content, first find that of the butt portion $a b c d$, then that of the tip part $a b f g$, and add them together for the total cubical content.

Sheer spars may not unfrequently be met with of such a form, or some slight modification of it.

Example. Find the weight of a sheer spar of Oregon pine 70 feet in length and having a mean circumference of 6.3 feet:—

πr^2 = the area of the mean section, where

$$\pi = 3.1416, r = \frac{6.3}{6.3} = 1 \therefore r^2 = 1$$

$$\pi r^2 = 3.1416 \times 1 = 3.1416 \text{ square feet}$$

$$3.1416 \times 70 = 220 \text{ cubic feet, very nearly.}$$

Now one cubic foot of Oregon pine weighs 37.8 lbs., the weight of the spar will therefore be:

$$220 \times 37.8 \text{ lbs.} = 8316 \text{ lbs.} = 3 \text{ tons } 14 \text{ cwt.}$$

Service oak skids are made of English oak and fir skids of Memel, Riga, or Dantzic pine, as may be available in the R.C.D.

Material and Appliances.

All service skidding is square or rectangular in section, and sheer spars are always circular in section or approximately so; the foregoing examples should therefore suffice the artilleryman for practical work.

TABLE OF WEIGHTS AND SPECIFIC GRAVITIES.

Material.	Specific Gravity.	Weight per Cubic Foot.
Water, Fresh	1	62½ lbs.
„ Sea	1.027	64 „
Iron, Cast	7.23	451 „
„ Wrought	7.78	485.6 „
Timber—Ash .. ..	.76	47 „
Elm, English .. ..	.54	34 „
Larch .. ..	.55	35 „
Oak, African .. ..	.98	62 „
„ English .. ..	.77	48 „
Pine, Dantzic .. ..	.65	40 „
„ Memel .. ..	.55	34 „
„ Oregon .. ..	.60	37.8 „
„ Pitch .. ..	.68	42.9 „
„ Red .. ..	.57	36 „
„ Riga .. ..	.65	41 „
Sabicu .. ..	.96	60 „
Teak, African .. ..	.98	61 „
„ Indian .. ..	.88	55 „

MAN POWER.

Maximum efforts exerted for short periods of time.

Pushing a load horizontally	100 lbs.
Pulling ditto	70 „
Tractive force in dragging a cart	40 „
Lifting a weight from the ground by the hands	150 „
Carrying on his shoulders, at 2½ miles an hour	120 „
Ditto by a man accustomed to the work	180 „

LUBRICANTS

Are used for reducing the friction between two surfaces in contact, and preserving material from the action of the atmosphere or damp.

The following table gives the natures of lubricants with their usual application.

(A. M.)

2 F

Material and Appliances.

Nature of Lubricant.	Use.
Beeswax	Edges of lubricating wads.
Coating—Composition of white lead or white zinc and tallow (parts 1 to 4)	Preserving bright metal surfaces and parts of gear, carriages, and platforms.
Ditto, ditto, cocoa nut oil and finely powdered chalk (equal parts)	Ditto ditto ditto
Grease—Fenners	Lubricating wheels and axles, also gear of platforms, applied to teeth of wheels.
„ Mineral	Ditto ditto ditto
Oil—Mineral	Lubricating gear and machinery and filling hydraulic buffers.
„ Rape.. .. .	Lubricating bearing surfaces.
„ Linseed	Used in combination with tallow for lubricating wads.
„ Olive.. .. .	Lubricating working parts of Gatling gun.
„ Lucca	For elevating gear, breech screws, &c.
Tallow—Russian	Packing for piston, hydraulic buffer, &c.
„ and Beeswax.. .. .	Luting.
„ „ and Oil	Lubricating parts of metal fuzes.

Lubricants used to reduce the friction between bearing surfaces should never be allowed to become hard or dry. When this has become the case the surfaces should be cleaned and the lubricant renewed.

PART VI.—ELEMENTARY INSTRUCTION.

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All stores, before being used, should be most carefully examined in every detail, to see that they are serviceable and suitable for the operation to be performed.

No store should be put to a use for which it is not intended; for instance, ropes or levers should not be subjected to a strain they are not constructed for.

It should be borne in mind that the destruction of any store may be attended with serious consequences, as it may not be possible to replace it at once, especially at out-stations.

Always apply power in the most advantageous direction.

See that supports and fulcrums have a firm base, and holdfasts are secure.

When there is a possibility of a weight *fetching way*, have a preventer rope or ropes attached to it. A heavy weight in motion implies a largely increasing force.

In this and the succeeding parts, the order of the words of command has been inserted, but this order may be changed as circumstances require.

(A. M.)

2 F 2

Elementary Instruction.

A detachment for instruction should consist of 19 Nos., and is formed up and told off as for M.L. gun drill.

(A gun of about 58 cwt. is lying on the ground.)

TO TAKE POST FOR EXERCISE.

Take post.
Right (or left) turn.
Double march.
Halt.
Inwards turn.

"Take post," "Right (or left) turn," "Double march," "Halt," "Inwards turn."

The detachment is marched and halted so that the even Nos. are on the right of the gun and the odd on the left, 2 and 3 in line with the muzzle, the whole facing inwards. In this position they are instructed in the general duties of the Nos. when engaged in moving guns, and in the names and uses of the various stores employed.

GENERAL DUTIES.

2, 3, 4, and 5. Muzzle handspikemen.

6 and 7. Place short skidding, scotches, rollers, fulcrums for the handspikes or levers, and assist to lash steady handspikes. 16 and 17 assist when required.

8 and 9. Place and attend to steady handspikes, make arrangements for slewing the trunnions, and supply 6 and 7 with rollers, if not engaged in steady the gun.

10 and 11. Place drag-ropes on muzzle and breech, the former on the muzzle, the latter on the breech.

8, 9, 10, and 11. Place long skids and planks. 18 and 19 assist when required.

12, 13, 14, and 15. Breech handspikemen.

When two parbuckle ropes are used, they are fixed by 6 and 12, 7 and 13; 12 and 13 fix the standing ends, 6 and 7 pass the running ends round the gun. The even Nos. haul on the muzzle, the odd on the breech, the lowest Nos. next to the gun; 2 and 3, or 2, 3, 4, and 5, assist with handspikes and scotches on their own sides.

When one parbuckle rope is used, 6, 7, 12, and 13 pass it round the gun in rear of the trunnions the requisite number of times, and 13 either makes it fast to one of the trunnions, or holds on to the end, as required.

Elementary Instruction.

In fixing tackles, 10 and 11 fix the standing blocks, 12 and 13 the moveable.

Before commencing any exercise it should be ascertained that the men know their several duties, by proving the Nos., thus, "*Muzzle handspikemen*," "*Prove*," &c.

STORES REQUIRED.

The following stores should be brought up by the Nos. who are to use them, viz.:—

8 handspikes..	..	..	..	by the handspikemen.
4 3' x 6" x 9"	} pieces of skidding	}	by 6 and 7, assisted by 16 and 17.	
2 3' x 6" x 6"				
2 3' x 4" x 4"				
2 3' x 3" x 3"				
4 large ..	} scotches ..	}		
4 medium ..				
4 small ..				
2 drag ropes..	..	..	..	by Nos. 10 and 11.
Parbuckle ropes, tackles, or selva-				
gees, if required ..	..	..	..	by Nos. 12 and 13.

TO ARRANGE STORES.

Arrange Stores.

"*Arrange stores*," the handspikes are laid down in rear of the Nos. who brought them up, the points of the handspikes inwards on the right side of the handspike Nos., at right angles to the gun. The skidding also in rear of the Nos. who provide it parallel to the handspikes, the scotches alongside the skidding.

The drag ropes in rear of the Nos. who brought them out.

DIFFERENT ORDERS OF LEVERS.

In the following exercises the commands to use the handspikes in the "*1st Order*" or "*2nd Order*" will be given, by which it is to be understood that the handspikes are to be applied as levers of the 1st or 2nd Order of the lever.

The portion, PF, of the handspike between the power and the fulcrum is called the lever, WF, between the weight and the fulcrum, the counter lever.

Elementary Instruction.

LEVERS. FIRST ORDER.

When the fulcrum is between the weight and the power applied to move it, the handspike is used in the 1st Order of the lever. Figs. 1, 2.

Fig. 1.

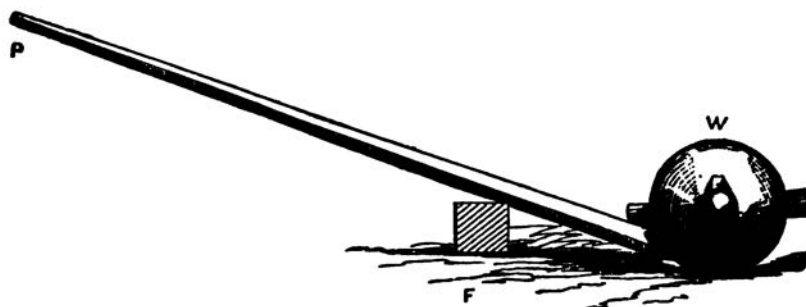
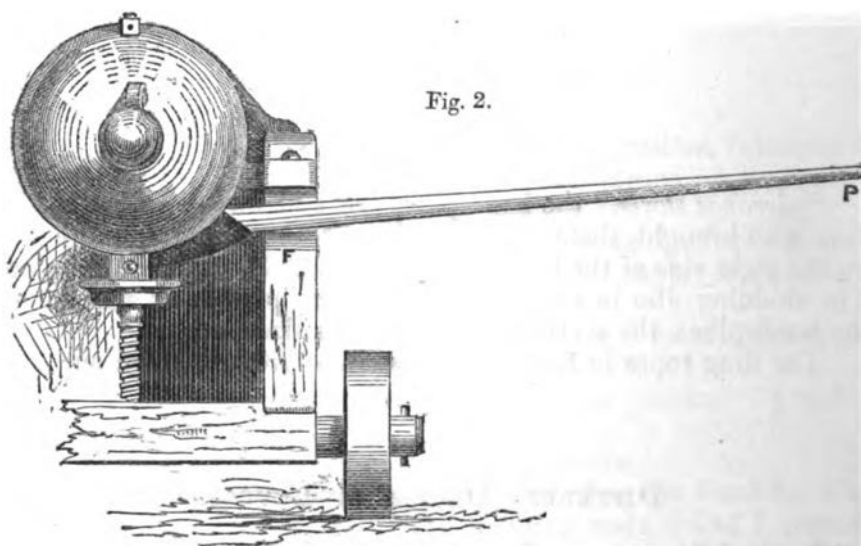


Fig. 2.



LEVERS. SECOND ORDER.

When the weight is between the power and the fulcrum, the handspike is used in the 2nd Order of the lever. Figs. 3, 4.

 Elementary Instruction.

Fig. 3.

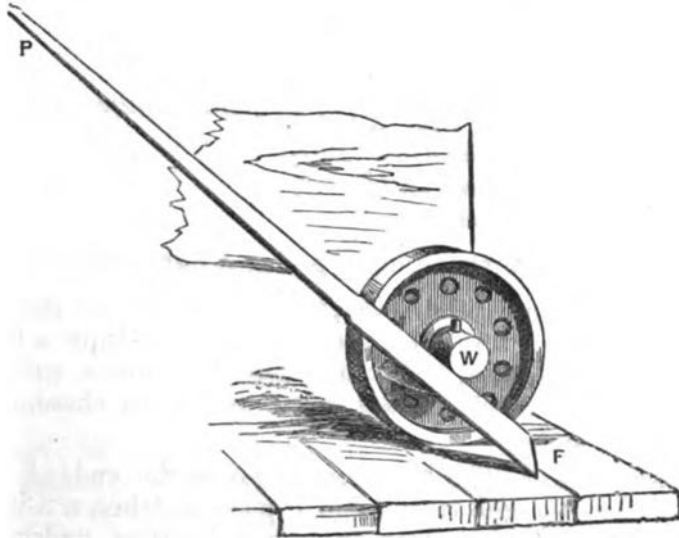
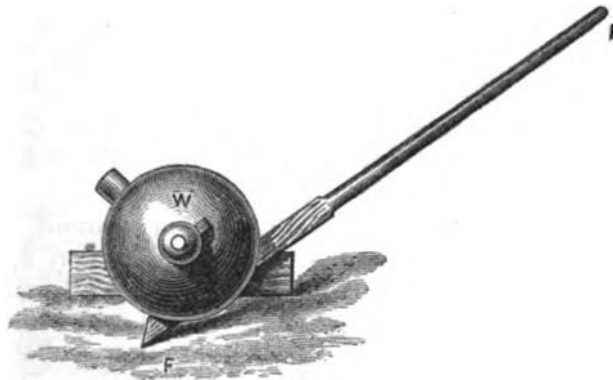


Fig. 4.

**TO RAISE A GUN ON TO SKIDDING.**

When handspikes can be applied under the chase.

In raising a gun on to skidding the muzzle should be raised first. In lowering, the contrary.

With handspikes, 1st Order.

Prepare to raise the muzzle.

Bear down.

Come up.

Scotch up.

With handspikes, 2nd Order.

Prepare to raise the muzzle.

Lift.

 Elementary Instruction.

*Lower.**Scotch up.**Arrange stores.**Take post.*

<i>By 1st Order</i>	} <i>Prepare to raise the breech.</i>
<i>" 2nd "</i>	

*Bear down (Lift).**Come up (Lower).**Scotch up.*

The muzzle is first raised, as giving a lighter lift.

"*With handspikes, 1st Order,*" "*Prepare to raise the muzzle.*—6 and 7 each place a skid parallel to the gun, within a few inches of the muzzle; 2, 3, 4, 5 take up their handspikes, and place the points with the bevelled sides down under the chase, using the skids as fulcrums.

"*Bear down.*"—The Nos. bear down on the ends of the handspikes, and as the gun rises 6 and 7 push scotches, a 3-inch piece, or any other skid for which there may be room, under the gun. As soon as this has been done "*Come up*" is given, the handspikemen allow the ends of their handspikes to rise, and remove them; 6 and 7 at once re-arrange the fulcrums, the handspikes are again applied, and "*Bear down*" again given; 6 and 7 get a piece of skidding under the gun near the centre of gravity; when the gun rests on the skidding, "*Come up,*" "*Scotch up*" is given.

If necessary, in raising the muzzle or breech, 12, 13, 14, and 15 will be ordered to double-man the handspikes of 2, 3, 4, and 5, or the reverse.

When the muzzle is sufficiently off the ground, "*2nd Order, Prepare to raise the muzzle*" may be given, when 2, 3, 4, and 5 will place their handspikes, bevelled sides up, well under the gun, using the ground as a fulcrum. "*Lift.*"—They lift until "*Lower*" is given, and the weight is taken by skidding, as before. When the muzzle has been raised sufficiently high, the gun is scotched up on a skid, near the centre of gravity.

"*By 1st Order*" } "*Prepare to raise the breech.*"—12, 13, 14, "*" 2nd "*" } and 15 use their handspikes as directed, 6 and 7 supplying fulcrums if necessary; the breech is raised, and a skid is placed in rear of the centre of gravity.

"*Come up*" or "*Lower.*"—The weight is allowed to descend on the skid, and at "*Scotch up*" 6 and 7 scotch up.

The muzzle and breech are now raised alternately by the handspikemen, 6 and 7 building up under the gun, and taking care that the base of the supports is firm, and neither likely to sink nor turn over.

When heavy guns are raised on skidding, they should not have a greater slope to the front or rear than 3 degrees.

Elementary Instruction.

TO ROLL A GUN OFF SHORT SKIDDING.

*Prepare to roll the gun to the right (or left).
Heave.*

"*Prepare to roll the gun to the right (or left),*" 6 or 7 will remove the scotches from their side; 3, 5, 13, and 15, or 2, 4, 12, and 14, assisted if necessary by the other handspike numbers, prepare to roll over the gun by placing their handspikes under it.

"*Heave,*" the Nos. lift on their handspikes, and the gun is thrown on the ground.

TO ARRANGE STORES.

Arrange Stores.

Arrange Stores.—The handspikes, &c., are placed as at the commencement of the exercise.

TO RAISE A GUN ON TO SKIDDING.

When handspikes cannot be applied under the chase, as may be the case when the gun has sunk into the ground.

*1st Order.
Prepare to raise the muzzle.
Bear down.
Come up.
Scotch up.*

"*1st Order,*" "*Prepare to raise the muzzle,*" 6 places a 6" x 9" skid on its edge, in front of the muzzle, as a fulcrum for the handspikes of 2 and 3; 4 and 5 double-man these handspikes, which are placed bevelled side down, in the bore of the gun.

"*Bear down,*" "*Come up,*" "*Scotch up,*" as before.

Or, 6 may be instructed to place a handspike or a skid in the bore, and the handspikes of the muzzle Nos. be placed under it, to lift either by 1st or 2nd order of the levers, as they did under the chase of the gun.

TO RAISE A GUN WITH A LEVER.

*Prepare to raise the muzzle.
Bear down.
Come up.
Scotch up.
Adjust the fulcrum.
Fresh purchase.
Bear down.
Come up.
Scotch up.*

 Elementary Instruction.

Stores as before, also a 10-foot or 12-foot lever, which is brought up by 2 and 3, and is placed in prolongation of the gun, point towards the muzzle.

"Prepare to raise the muzzle," 2 and 3 lift the small end of the lever, 4 and 5 the point, which they rest on the muzzle of the gun until 6 and 7 have placed a fulcrum for it; they then place the point either in the bore of the gun or under the muzzle, and 2, 3, 8, 9, 10, 11, 4, and 5 prepare to bear down, 2 and 3 being at the small end, the other Nos. placing themselves in order towards the point.

"Bear down," &c., as before.

When the fulcrum has to be raised, *"Adjust the fulcrum"* or *"Fresh purchase,"* 4 and 5 lift the point of the lever on to the top of the gun, 2 and 3 attending to the small end.

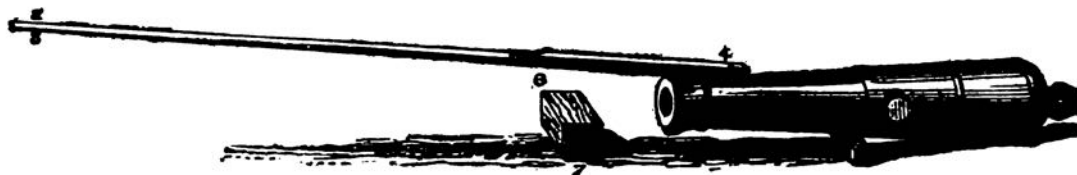
In raising the breech, 12, 13, 14, and 15 take the place of 2, 3, 4, and 5, the other Nos. as before. Figs. 5, 6.

RAISING MUZZLE WITH LEVER.

Fig. 5.



Fig. 6.



TO LOWER A GUN WITH HANDSPIKES OR LEVER.

The same words of command are given, and the same duties performed by the Nos., as in raising; 6 and 7 are to be instructed to arrange the skidding and fulcrums, so that the weight shall be received on the former before the small ends of the handspike or lever have risen too high, to prevent the fulcrums turning over. They should at all times be ready to scotch up when ordered.

TO RAISE HEAVY GUNS ON TO SKIDDING.

Heavy guns are raised on to skidding either by levers, gins, or jacks.

Elementary Instruction.

*By Lever.**Stores Required.*

Drag ropes, heavy	1
Lever, 14-feet	1
Planks, oak, half, 6' x 12" x 3"	4
Scotches, of sorts	8
Skids, fir, 4' x 12" x 12"	3
Do. do. 3' x 9" x 6"	4
Do. do. 3' x 6" x 3"	2

The muzzle is first raised by the lever till high enough to get an oak plank with a 6" x 9" over it under the short coil, on which the gun is scotched up.

The breech is then raised; the first lift, a flat 3" piece or an oak plank may be got under the breech coil, and the next lift six inches of skidding, and so on until the gun is skidded at the required height with the axis horizontal.

It is a good plan to make fast the centre of a heavy drag rope with a clove hitch to the small end of the lever, to assist the Nos. applying it.

If the ground is soft, planks should be placed under the skidding and fulcrums.

By Gyn.

(*Vide Part VII., Sect. I.*)

By Jacks.

The breech and muzzle are raised alternately, care being taken not to get the gun too much out of the horizontal. *Vide* page 498 *et seq.*

TO SLEW THE TRUNNIONS OF A GUN

Is to turn the gun on its axis, so as to bring the trunnions into any required position.

The trunnions may be slewed, to bring them horizontal or vertical, by attaching a lever or handspike to a trunnion, in the same manner as is done in steadying a gun (page 453), and scotching up under the gun with a piece of iron, or greased scotches*, on the side towards which it is to be turned, or by passing the bight of a rope round the gun once or twice, and placing the point of a lever or handspike through it, and bearing down or lifting up, using the gun as a fulcrum, the ends of the rope being held to prevent them slipping, the gun being scotched as before. Two levers may be employed in this way at the same time, in concert with that on the trunnion. The friction of the gun on the skids should be reduced as far as possible by skidding

* The iron point of a picket or hook of a drag rope answers well for light guns.

Elementary Instruction.

the gun on oak and watering the skids. With very heavy guns, to still further diminish friction, greased iron plates may be interposed between the gun and the skids.

Should the greased scotches be forced from their position in slewing, they should be secured by placing a handspike or lever across both of them and lashing it. With the heavier natures the trunnions may be slewed with a gyn or overhead tackle, lifting jack or lever applied under a trunnion, or by using two or more levers applied as previously described.

Unless the axis of the gun is horizontal the gun will travel towards the lower end.

By Levers.

A lever should be lashed as for light guns, and a tackle made fast to the end of it. If the trunnions are perpendicular, another tackle may be applied to the lower trunnion; but when the lower trunnion is so situated that a purchase can be taken under it, a second lever should be applied.

Two or more levers may be used in the manner previously described at page 451.

Skids should be watered, or other means taken to lessen friction.

By a Gyn.

The gyn should be placed so that the tackle is over the trunnion to be raised, a sling is then passed round one trunnion, brought up under the gun, and the tackle hooked into it.

By Jacks.

If the gun is so situated that a jack can be applied under a trunnion, it may be slewed by so placing and working the jack.

This, being a very slow process, is only applicable when but little slewing is required.

Trunnions may be slewed by rolling the gun over, and then cutting it back into its place.

TO SLEW A GUN END FOR END

Is to turn it round, not allowing it to revolve on its longer axis.

Skidding is placed under the gun, as near the centre of gravity as possible, and a lever put in the bore; 8 and 9 with handspikes prevent the gun rolling as the muzzle is carried round in the direction required; the skidding is adjusted as necessary by 6 and 7.

TO CUT A GUN.

To cut a gun is to cause it to move horizontally, without rolling, by moving breech and muzzle alternately in the required direction.

Heavy guns up to 12 tons can be cut by a lever placed in the bore.

Elementary Instruction.

The skids on which the gun to be cut rests should be close to its centre of gravity.

The end of the gun opposite to that to be moved should be scotched up.

TO PINCH A GUN.

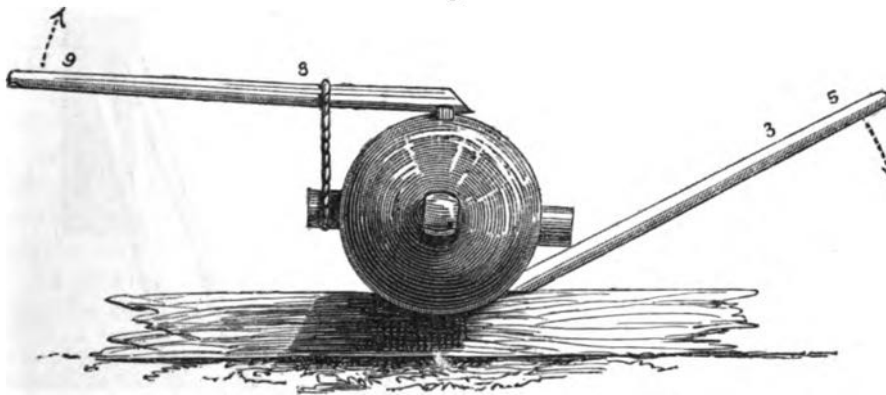
Pinching is the operation of moving a gun by small heaves of the handspike, without allowing it to turn on its axis.

It is only applicable to the lighter natures.

If a gun resting on skids is to be pinched sideways, a steadying handspike is first placed, as in slewing trunnions. Fig. 7. Two handspikes are then held with their points close to the gun bevel under, one resting upon each skid, on the side opposite to that towards which the gun is to be moved. At "*Bear down*," the small ends are brought down, and the gun moved as described in the preceding paragraph.

When the breech is pinched back, as when on an inclined plane, a handspike must be applied as a scotch at the opposite side of the chase, and when the muzzle is pinched backwards or forwards at the opposite side of the breech.

Fig. 7.



TO ROW A GUN.

Rowing is the operation of moving a gun in the direction of its length.

The handspikemen on each side apply their handspikes on the skids on which the gun rests,* under the gun, as levers of the first order, the small ends being in the direction it is intended to move the gun; a drag-rope is attached to the breech or muzzle, as required, to be hauled on by all the remaining Nos. of the detachment.

At "*Row*" and "*Heave*" the Nos. bear down and bring the small ends smartly in a direction opposite to that in which the

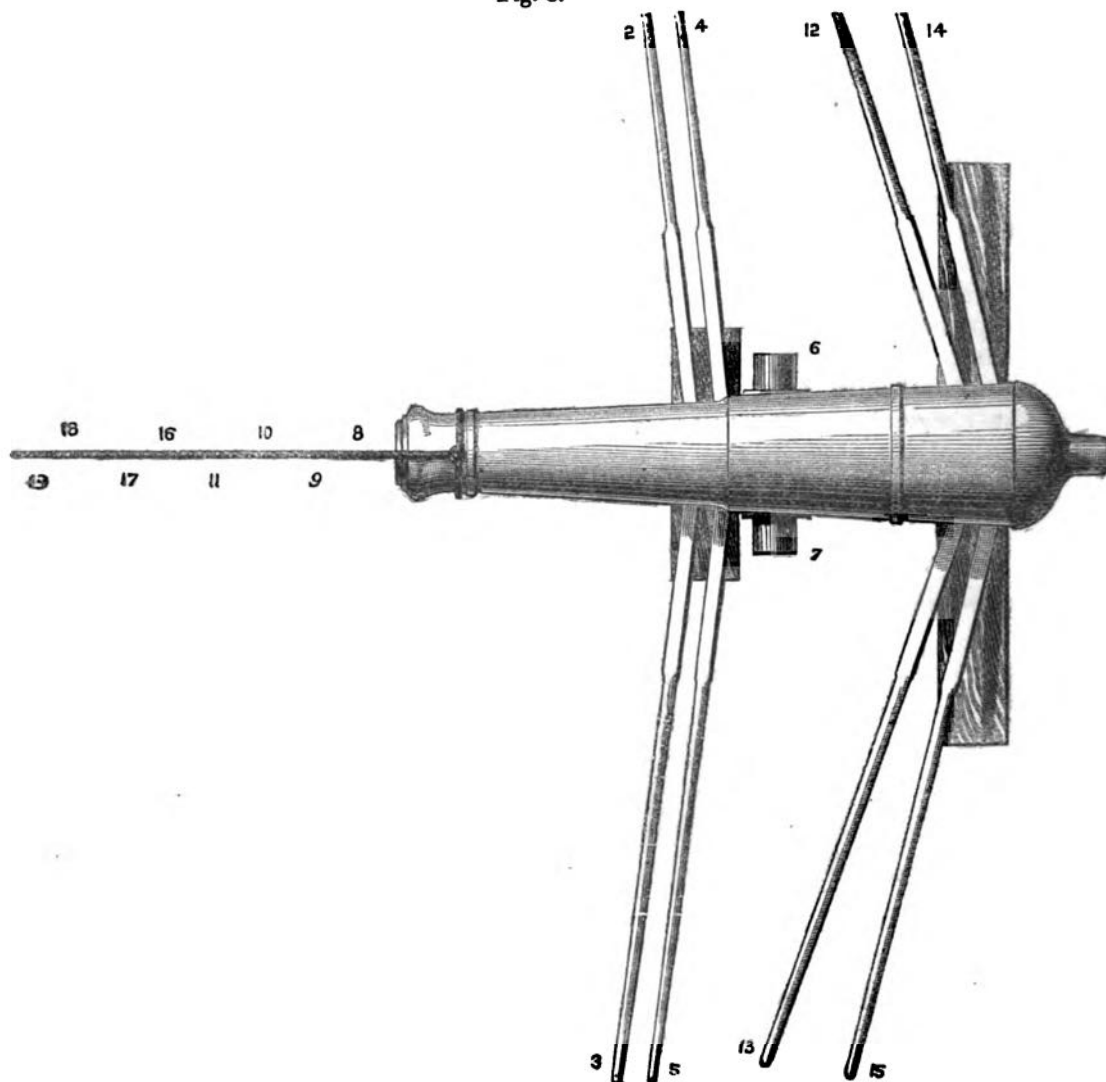
* It will generally be necessary to place extra fulcrums for this operation.

 Elementary Instruction.

gun is to move, moving together as in rowing a boat; the Nos. on the drag-rope hauling at the same time. Fig. 8.

If possible, the gun should have a safe inclination in the direction it is to move. 6 and 7 attend to scotching up.

Fig. 8.



TO PARBUCKLE A GUN.

Parbuckling is the operation of rolling a gun by means of ropes (parbuckle ropes) passing round it, which operation may be performed when the gun rests on skidding sufficiently high to allow of its trunnions revolving without touching the ground.

As the breech is larger than the chase, it advances more rapidly, which must be corrected from time to time. This is done either

Elementary Instruction.

by scotching up the breech and hauling forward the muzzle, or sometimes, when on an incline, by scotching up the muzzle and pinching back the breech. Neither should be done too much, otherwise the trunnion will be stopped by the skid.

Pinching back the breech can only be done with the smaller natures. With heavy guns the muzzle has always to be cut or hauled forward.

A gun may be parbuckled—

1. By a single parbuckle rope either passed round the gun a certain number of times, and secured to a trunnion, or else passed round the gun in the ordinary way, and made fast to a holdfast.

2. By a single running parbuckle rope.

3. By two parbuckle ropes, one in front and one in rear of the C G.

With a single standing parbuckle the running end comes off next to the breech.

With a single running parbuckle the running end (that hauled on) comes off next to the trunnions.

In all cases, in parbuckling a gun up an incline, the running end of the parbuckle rope should come off above the gun: in parbuckling down an incline, the reverse when two parbuckle ropes are used, but the same when one is used, made fast to one trunnion.

Two parbuckle ropes should invariably be used when the incline is greater than 10° .

In parbuckling, the longer axis of the gun should be kept horizontal; the muzzle may be brought up sufficiently by placing an oak plank on the skid. The trunnions should also be kept as close to the breech skid as possible, leaving sufficient room to prevent the rope from cutting the edge of the skid, so that the muzzle may be moved easily backwards or forwards as required.

In placing skids for parbuckling, they should be slightly lower than the skids on which the gun is resting.

Place skids.

Fix parbuckle rope (or ropes).

Unscotch.

Taut,—Heave.

Halt.

Scotch up the breech.

Forward the muzzle.

Halt.

In addition to the stores before detailed, the following stores are brought up:—

2 and 3 bring up a lever.

8, 9, 10, and 11, two parbuckling skids.

12 and 13, parbuckle rope or ropes.

Elementary Instruction.

On Level Ground.

"Place Skids."—The parbuckling skids are placed so as to overlap those on which the gun rests about 6 inches, and should be placed at about 3 feet apart, that of the breech about a foot from the trunnion; if there is any difficulty in placing them thus, the muzzle and breech can be lifted alternately, and the skids launched under the gun, or the long skids may be made to abut against the short ones, and other pieces of skidding be used to break joint, and prevent the gun slipping down between them.

"Fix Parbuckle rope."—In the case of a standing parbuckle rope, it is passed round the gun by 6 and 7 four or five times, and then made fast to one of the trunnions by 12 and 13; in the case of a running parbuckle rope, three turns may be taken; and 12 and 13, assisted by 6 and 7, if necessary, hold on to the end; these Nos. keep the rope in its proper position on the gun.

"Unscotch."—2 and 3 unscotch the gun.

"Taut,"—"Heave."—The former is only a caution for the Nos. to stretch the rope, and be ready to heave together. 2 and 3, or 2, 3, 4, and 5, assist to roll the gun over with handspikes, and place scotches, &c. The other Nos. not specially employed heave on the rope.

When it is necessary to bring the muzzle forward, *"Halt," "Scotch up the breech," "Forward the muzzle,"* are given. The handspikemen pinch forward the muzzle, or the running end of the parbuckle rope is brought in front of one of the trunnions, and a hitch taken with it round a skid in the bore, the Nos. on the rope hauling, whilst the others lift with levers or handspikes, or it may be hauled forward by means of a tackle or drag rope.

Or one end of a short rope may be fastened to a skid in the bore, and the other end with a stopper hitch to the parbuckle rope, so as to admit of its being utilized to haul forward the muzzle. When the muzzle has been thus moved sufficiently forward, the stopper hitch is cast off, the parbuckling continued, and the short rope coiled on the skid till required again.

When the muzzle is somewhat in front of the breech, the parbuckle rope is arranged for hauling, the gun unscotched and made to revolve as before.

It will be found that it will facilitate the moving forward the muzzle by doing so when the gun is in motion.

The short skids are brought up by 8, 9, 10, and 11 (or by other Nos. detailed for the duty), and arranged so as to receive the gun as it comes off the long ones; when it does so, they bring up the long skids and place them as before, the gun remaining scotched up on the short skids in the interim.

Up or Down a Slope.

In parbuckling up or down a slope, where two parbuckling ropes are used, one is placed round the breech, the other round the muzzle.

Elementary Instruction.

One end of each of the parbuckle ropes is passed under or over the gun by 6 and 7, and made fast to pickets or some suitable holdfasts by 12 and 13, whilst the remaining Nos. man the other ends.

Parbuckling Heavy Guns.

The following stores are required:—

- 8 7-foot handspikes.
- 4 skids, 20' × 15" × 15".
- 2 „ 4' × 12" × 12".
- 1 14-foot lever.
- 2 heavy drag ropes.
- 1 parbuckle rope, 6".
- 8 scotches.
- 4 oak planks.
- 1 water bucket, filled, and brush.
- 4 oak skids, 3' × 6" × 3".

In parbuckling heavy guns, unless the greater part of the weight is kept on the breech skid, it is difficult to haul the muzzle forward.

When the skids have only a bearing at the ends, the breech skid should be well supported intermediately.

Where skids laid in continuation do not overlap, short skids 4' × 12" × 12" should be placed outside the long skids to break joint, with planks or skidding on top as required.

Oak planks should be laid on the muzzle skids, and so placed that their junction should not be over that of the skids.

The muzzle should be rolled and not hauled forward over a joint between two planks.

In parbuckling, if the breech has to be raised on to a skid slightly higher than that on which it rests, it can be done by using an inclined plane, such as a large coin.

The instructions contained in the following extract, from "Notes on Moving and Mounting 35 and 38-Ton Guns," will be found generally applicable to all the heavier natures.

In parbuckling heavy guns, stability of roadway must be ensured by supporting the parbuckling skids at short intervals.

The 35-ton gun has the trunnions placed so far aft on the breech coil that the gun will take a skid on this coil in front, as well as in rear, of its centre of gravity; hence it may be rolled straight to the front or rear on this cylindrical coil, and thus "cutting forward the muzzle" may be dispensed with, unless it is desired to change the direction.

In parbuckling* the gun in this manner, it is well to use oak planks over the fir skids, for the skid in front of the trunnions lies, of necessity, so very close to the centre of gravity that it

* NOTE.—Average resistance in parbuckling on level: on fir skids, $\frac{1}{10}$ th of weight; on oak skids, $\frac{1}{8}$ th of weight.

(A. M.)

Elementary Instruction.

must take the greater part of the weight of the gun, and under such circumstances a fir skid, unless thus protected, is soon rendered unserviceable.

A traction engine has been found very useful to give the motive power when parbuckling these heavy guns, and in cutting forward the muzzle.

In parbuckling 38-ton guns, the following are the main points to be observed:—

1st. The axis of the gun should be kept horizontal.

This may be secured by keeping about nine inches of oak (planks or skidding) on top of the muzzle skid under the short coil.

If the axis is not kept horizontal, not only has the gun a constant tendency to lurch to the lowest end, but the weight is thrown unfairly on the skids, which are then soon destroyed.

2nd. It is well to use two skids under the breech coil, because, unless the greater part of the weight is kept on the breech skids, the muzzle is not sufficiently under control for cutting forward, and if such pressure has to be taken by one skid, it suffers in proportion.

It has been found that, when these points have been attended to, the skids under the breech, even when unprotected by oak, receive but very little injury. They should be placed as follows—viz., the front breech skid about six or eight inches in rear of the trunnions, and the second close behind it; the muzzle skid and planks (which should be kept clear of grit and well watered) rather in front of the centre of the short coil.

Cutting forward the muzzle is effected in the ordinary way, only more power is requisite. The harder the surface on which it rests, the less the friction. It is a good plan to keep greased iron rails or plates on top of the muzzle skid, and incline the breech scotch to diminish the resistance.

On the level, the following will be about the purchase required:—

An 8-ft. 12-in. oak roller is used as a muzzle fid, and allowed to project about 3 feet out of the bore; near its outer end a short 6-inch rope sling with thimble is placed, as a means of attaching the tackle, consisting of one double and one single 12-in. Bothway block, rove with 4-inch fall, led away to crab capstan.

The capstan Nos., walking round as the gun is parbuckled forward, cut the muzzle at the same time.

In rising a slope, and even occasionally on the level, if too much weight is allowed to get on the muzzle skid, it will be advisable to aid the operation by using a 14-foot lever (1st order) at the muzzle, thus reducing pressure and friction on the muzzle skid, which should be lashed to prevent it moving—should its so doing be undesirable.

In parbuckling up or down a slope, the same precautions, only in an extra degree, apply as with lighter guns. (*Vide* page 456.)

It may here be noted that, if the gun has to be moved over

Elementary Instruction.

any but a very short distance, it will be a saving to do so by sleigh and rollers, in preference to parbuckling.

The average rate of progression will depend on the nature of the ground and the number of men employed. Over bad ground, with 40 men, it will be *about* 30 feet per hour.

Parbuckling off a Trolly (Railway)—Sleigh, &c.

In parbuckling these guns off a trolly, two cases present themselves for consideration.

Firstly, when the gun is on short skidding on the trolly high enough for it to be rolled off at once on to the long skids.

Secondly, when the gun has only low skidding, or oak planks, under its breech coil. In this latter case it will be necessary to see that the short skids or planks on which the gun rests have their ends flush with the edge of the trolly, on that side on which it is intended to roll the gun off; and should there be any chance of the trunnion not clearing the side of the trolly, it may be slewed a little upwards.

* The long skids *a, b*, are then butted close up against the short skids, or planks on which the gun rests, and are skidded up to the same level. *Vide Fig. 9.*

The supporting skids at *a* are close to the trolly, the second lot at *c* about 6 feet out, and the outer ends of the long skids are temporarily supported at *b*, until the gun has rolled beyond the point *a*. The support at *b* is then removed, and as the gun passes beyond *c*, the ends of the long skids are allowed to dip.

They are then skidded up under at short intervals between *c* and *b*, where their ends meet the ground.

The plan shows the mode of lashing the long skids back to the trolly, to guard against their moving away from the trolly when they receive the weight, for should they do so they would probably upset the supporting skidding, and let the gun down; *a, b, c, d, e*, is a $4\frac{1}{2}$ -inch parbuckle rope, held in position by the three luff tackles, *a* and *e* at the two ends, and *c* at the bight. The rope itself lies round the outer end of the parbuckle skids, and keeps them in position.

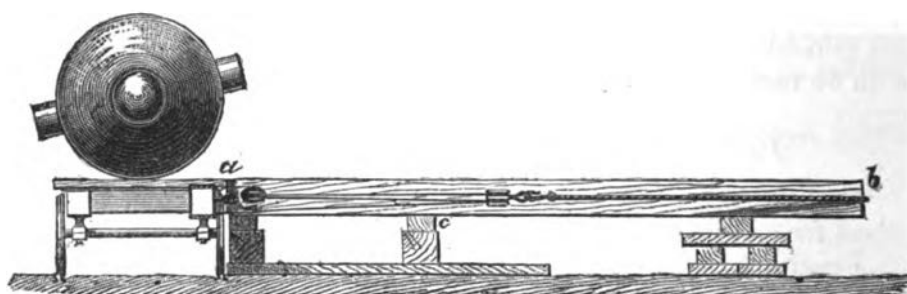
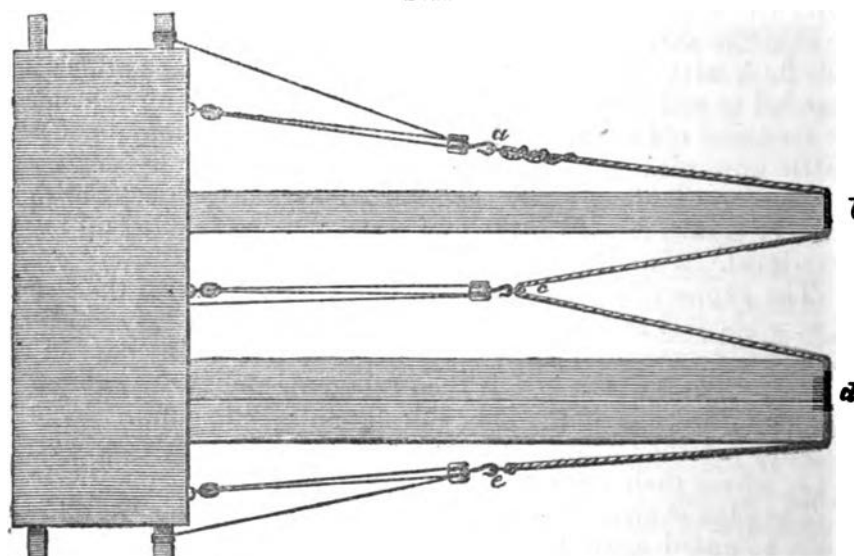
By following this plan perfect security is obtained, and the long and tedious operation of jacking the gun up until it can be skidded high enough to enable it to be rolled straight off the short skids, on the trolly, on to the long parbuckle skids, when the latter are resting on the edge of the trolly, is avoided. The usual precautions, as regards check ropes, when going down the incline (between *c* and *b* in the elevation) must of course be attended to.

Parbuckling on to a trolly is the converse of the latter, and calls for no special remark; but it may be as well to observe that in either case it is advisable to lash the muzzle skid, to prevent its moving in cutting forward the muzzle, which otherwise it is nearly certain to do from the great pressure and friction, even if levers are used to aid the operation.

(A. M.)

2 a 2

Elementary Instruction.

Fig. 9.
Elevation.*Plan**Shewing the mode of lashing the long skids back to the trolley.*

TO MOVE A GUN ON ROLLERS.

Some guns, such as the 64 and 80-pr. R.M.L. converted guns, are of such a shape that they can be very easily moved on rollers, over considerable distances, whilst others, such as the 7-inch R.B.L. guns, are especially unsuited for this mode of transport.

All the "Woolwich" guns can, without difficulty, be moved short distances to front or rear on rollers, a steadying lever being secured to the trunnions or jammed through the breeching loop, and the rollers applied, one under the breech coil, the other under the short coil or chase, the latter being raised by skidding to a sufficiently high level to keep the axis of the gun horizontal.

Owing to the necessity for constantly readjusting the rollers, this mode of moving the heavier natures of guns, can only be considered applicable in cases where but a short distance has to be traversed.

The following description has reference to a 64 or 80-pr.

Elementary Instruction.

converted R.M.L. gun, with which elementary exercises would be usually carried out.

To Move a Gun on Rollers.

The gun to be resting on two short skids 9 inches from the ground.

2nd Order—Prepare to raise the breech.

Lift.

Place the roller.

Lower.

Scotch up.

2nd Order—Prepare to raise the muzzle.

Lift.

Place the roller.

Lower.

Scotch up.

Fix Steadying Handspikes.

Fix Muzzle (Breech) Drag-rope.

Taut. Heave.

The following additional stores are required:—

Skids, 3' x 6" x 3"	2	} Provided by 6 and 7.
Rollers, 3' x 6"	3	
Mauls	2	
Ropes lashing, 1½ inches	2	} Provided by 8 and 9.
Handspikes, 7 foot	2	
Planks, 6' x 3" x 12"	4	} Provided by 8, 9, 10, and 11.

"2nd Order. Prepare to raise the breech."—The breech is raised, the skid is removed.

"Place the roller."—A roller is placed under the gun as near the centre of gravity as possible by Nos. 6 and 7.

"Lower," "Scotch up."—The gun is lowered on to the roller, and is scotched in front, rear and on top.

"2nd Order. Prepare to raise the muzzle."—The muzzle is raised, the skid is removed.

"Place the roller."—A roller is placed at the same distance from the breech roller that the latter is from the breech end of the gun.

"Lower," "Scotch up."—As before.

"Fix steadying handspikes."—Nos. 8 and 9 each lay a 7-foot handspike over the gun, bevel down, so that the points may be over the trunnions on the opposite side. No. 8 makes a timber hitch on the right trunnion with the lashing rope, and takes three or four turns round his own handspike, the point of that of 9, and the trunnion. No. 9 makes fast his own handspike, and that of 8 in the same way, they frap the returns at the same time, and make fast with a clove hitch, 6 and 7 holding the handspikes in their places whilst they are being lashed.

"Fix muzzle (breech) drag-rope."—If the gun is to be moved muzzle foremost, No. 10 makes his drag-rope fast round the

 Elementary Instruction.

muzzle, and the remaining Nos., except 8 and 9, at the steadying handspikes, and 6 and 7 at the rollers, man the drag-rope.

When the rear roller leaves the gun, the front roller should be under the centre of gravity. Nos. 6 and 7 have a third roller ready, and, as the muzzle rises, place the roller so as to receive the muzzle when it dips. This roller must be so placed that it will arrive under the centre of gravity as the other leaves the gun; by 6 and 7 placing the rollers judiciously and square to the gun much trouble is avoided.

If it is desired to change directions to the right or left the front roller should be cut in the required direction, and the rear roller in the contrary direction, Nos. 6 and 7 using mauls as required.

It is generally found most convenient to move the gun breech foremost.

Should it be required to take the gun through a narrow passage where steadying handspikes could not be made fast in the usual way, the difficulty may be overcome either by jamming one handspike through the breeching loop, or if that is still too wide, by suspending a handspike alongside the gun under each trunnion; a few returns of light lashing passed over the gun from handspike to handspike serve to suspend them near each end, and a turn or two taken underneath the gun to keep them from opening out.

The 64 and 80-pr. can be very readily transported in this manner on rollers without constructing a sleigh for them.

TO PLACE A GUN ON ROLLERS, WITH PLANKS UNDER THEM.

The gun is skidded on two 6" x 8" on their edge, one in front and one in rear of the centre of gravity.

The breech is raised with a lever applied under the cascable: the fulcrum being placed fore and aft, in prolongation of the axis of the gun, so as not to interfere with laying the plank roadway, fig. 10.

Fig. 10.



The breech skid is removed, and two planks parallel to the gun and about a foot apart are launched up to the front skid at A: on these are placed two 6-inch ground rollers, one in front and one in rear of the centre of gravity; the gun being lowered on to them, is scotched up, front, rear, and on top.

The muzzle skid can now be knocked out and steadying handspikes applied in one of the ways previously described.

PART VII.—MACHINES AND TRANSPORTING CARRIAGES.

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Section I.—Triangle Gyns.

Triangle gyns are generally spoken of simply as "Gyns," and this will be adhered to in the following description: the Gibraltar Gyn, which is an entirely different kind of machine, will be found described at page 484.

Gyns give a mechanical advantage of about 19 to 1 independent of the tackle.

Gyns were formerly made of wood, and although the manufacture of wooden gyns has been discontinued, they will doubtless be met with for years to come at many stations.

There are three kinds of wooden gyns, viz. :—

The 16-ft. (manufacture discontinued, but will still be met with.)

The 18-ft. light.

The 18-ft. heavy.

The 16-ft. gyn weighs about 9 cwt., and will raise 70 cwt. when furnished with wrought iron, and 60 cwt. with cast iron fittings.*

The 18-ft. light gyn weighs about 13 cwt., and will raise 7 tons with wrought iron fittings, and 6 tons with cast iron.

The 18-ft. heavy gyn is furnished with wrought iron fittings, and is calculated to raise 12 tons.

* The wrought iron fittings of gyns may be distinguished from cast iron by the difference in the form of the teeth of the ratchet on the windlass.

When wrought iron the faces and edges of the teeth are straight, when cast iron the upper face of the teeth are curved or hog-backed.

Section I.

Gyns.

Iron gyns are manufactured of the same dimensions as the wooden—they are slightly heavier, and constructed to raise the same weights as detailed for wooden gyns with wrought iron fittings. Those first introduced were fitted with head bolt and shackle, but the latest pattern have a head bolt only and no shackle, the introduction of the forked prypole enabling the hook of the upper block of the tackle to be placed over the head bolt, thus securing several inches more lift.

A gyn consists of two cheeks, with cross-bars, a prypole, a windlass with levers, a head-bolt, or head-bolt and shackle, according to the pattern, three shoes or trucks for the feet, and a tackle.

The wooden gyns have two crossbars.

The 18-foot heavy gyn has two link loops fitted to the cheeks above the upper crossbar to receive a handspike, on which men may stand when hooking the tackle.

Those heavy 18-foot gyns which have not the forked prypole have an iron loop on top of the prypole, into which is hooked the block used for raising the tackle.

The 18-foot heavy iron gyns have three crossbars.

Details of the tackles employed with each nature of gyn will be found under stores required in working.

The splay of a gyn is measured from the foot of the prypole to the point where a perpendicular let fall from the centre of the windlass meets the ground.

The maximum splay allowed for an 18-foot heavy gyn is 15 feet.

For an 18-foot light gyn 13 feet.

For a 16-foot gyn 12 feet.

The following are the main points to be attended to in working with gyns:—

The prypole is always considered to be the front.

The gyn should be placed with its head over the centre of gravity of the weight to be raised.

All three feet should be on the same level, and properly supported.

Before taking the weight, the foot of the prypole should be lashed to the cheeks.

The foot of the prypole should be equidistant from the feet of both cheeks.

The maximum splay allowed should not be exceeded.

If the windlass is very hard and slippery, one or two extra turns round it may be taken with the fall to guard against a slip.

A suspended weight may be hauled straight towards the centre of the windlass or towards the prypole without risk of upsetting the gyn, but hauling it to either flank is liable to cause a capsize.

Steadying ropes or tackles should always be attached to the weight to keep it from swinging when raised.

16 and 18-foot Light Gyns.

Section I.

If the weight to be lifted should be to the front or rear of a plumbline let fall from the head of the gyn, the weight when raised will swing in towards either the cheeks or prypole unless kept in hand by the steadying ropes or tackles.

In lifting a weight with two gyns, if of the same nature, they should be so placed as to take an equal weight; if of different natures a proportionate weight. In such cases the cheeks should, as a rule, be on opposite sides of the gun.

In carrying a gyn the more upright it is the easier to carry, being more under control. In carrying to front or rear, the prypole should be secured by a dragrope to the windlass to guard against the prypole being separated too far from the cheeks, which might cause an accident by letting the gyn down.

In placing, carrying, raising or striking a gyn, the officer in charge should place himself so that he may observe the whole work and especially the position of the prypole with reference to the cheeks: this is most important.

In raising or striking heavy gyns, two dragropes joined together should always be made fast to the prypole, passed round the windlass and held on to, and even with light gyns when working with a weak detachment or young soldiers, this will be found a wise precaution.

In placing and carrying heavy gyns, should the work appear too heavy for the detachment, it is well to make use of an extra lever or 7-foot handspike, applied under the centre of the windlass, and manned by four Nos., to make light work of it.

It is well to bear in mind that the cheeks of the *iron* gyns are interchangeable, so that if a gyn be put together with the right cheek where the left should be, and vice versa, it will not be necessary to take the gyn to pieces and alter the arrangement of the cheeks, the windlass pawls may be taken off, reversed, and put on again.

16-ft. and 18-ft. Light Gyns.

The detachment consists of 13 Nos., told off as for M.L. gun drill.

TO ARRANGE STORES.

The several parts of the gyn are brought up by the whole detachment and placed in a convenient position, ready to be put together.

Arrange Stores.

The stores are brought up as nearly as possible by the Nos. who are to use them, i.e.: —

Section I.

16 and 18-foot Light Gyns.

1. A hammer and a piece of spunyarn.
- 2 and 3. Each a gyn lever and 6-foot handspike.
- 4 and 5. Each a 6-foot handspike.
- 6 and 7. Three gyn trucks, one spade, and one pickaxe, if required.
- 8 and 9. Each two heavy drag ropes.
- 10 and 11. A set of tackle consisting, for the 18-foot light gyn, of two treble 12-inch Bothway's blocks and 4-inch fall, 18 fathoms long, or, for the 16-foot gyn, of one double and one treble 10-inch Bothway's block, and 3½-inch fall, 15 fathoms long.
- 12 and 13. Gun sling, according to the gun and fid.

"Arrange Stores."—The stores are laid down near the places where they will be required, viz., the levers and handspikes to the right and left of the feet of the cheeks of the gyn, points to the front, the trucks where the feet are to stand, the tackle on the right, the upper block in line with the head of the gyn, the lower one in line with the upper crossbar, the fall on the right, neatly coiled and free to run, the sling and drag-ropes near the weight to be lifted.

The detachment then falls in, in rear, facing to the front.

GENERAL DUTIES.

No. 1 Commands.

Left side.

3. Has charge of the left lever.
5. Assists 3 at the lever.
7. Assists 6 to pass the fall round the windlass, holds on next to him.
9. Holds on the fall behind 7, and coils it down.
11. Reeves and unreeves the upper block, assists in slinging and steadying the gun.
13. Assists 3 and 5 to work the lever.

Right side.

2. Has charge of the right lever.
4. Assists 2 at the lever.
6. Passes the fall round the windlass, holds on to it, makes it fast, eases it off, and lowers the gun.
8. Holds on the fall behind 6.
10. Reeves and unreeves the lower block, assists in slinging and steadying the gun.
12. Assists 2 and 4 to work levers.

TO TAKE POST ON THE GYN.

Take post on the gyn.

Right turn.

Double march.

On the above commands being given the detachment turns to the right, then wheels to the left, opening out, and halts, the front

16 and 18-foot Light Gyns.

Section I.

rank covering the left cheek, the rear rank the right; 2 and 3 halting one pace from the cheeks, the other Nos. one pace from each other.

TO PUT THE GYN TOGETHER.

Put the gyn together.

Place the windlass.

"*Put the gyn together,*" 2 unkeys the upper crossbar, and passes it to 3; 3 unkeys the lower one and passes it to 2; 6 and 12, 7 and 13 assist to pass the crossbars to 2 and 3, after which they place the windlass between the cheeks. 9 unkeys the prypole-bolt, which 8 draws out; 4 and 5 at the cheeks, and 8 and 9 at the prypole, then bring the top of the gyn together, the prypole between the cheeks. 4 holds up the top of the right cheek, 9 the top of the prypole, 5 the shackle, and 8 passes the bolt through them. 5 then raises the top of the left cheek; 8 passes the bolt through it, and 9 replaces the key, Fig. 1.

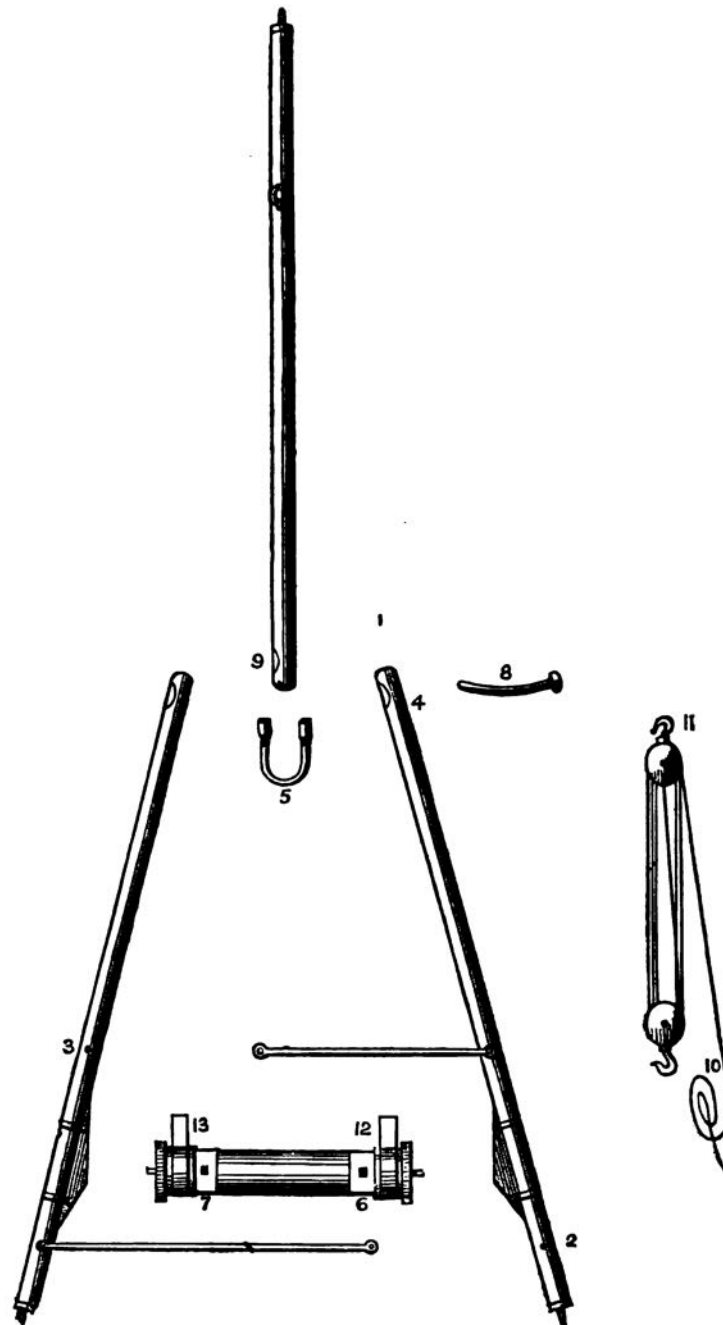
"*Place the windlass,*" 6, 7, 12, and 13 hold up the windlass; 6 puts the right gudgeon into the gudgeon-hole of the right cheek; 7 and 13 bring the left cheek towards the right, until the left gudgeon is, in like manner, placed in its gudgeon hole; 2 and 3 assist during the operation by applying handspikes under the spikes of the gyn cheeks on their respective sides; when it is completed, they close the cheeks upon the windlass, and bolt the bars.

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16 and 18-foot Light Gyns.

Fig. 1.

Putting the gyn together.



16 and 18-foot Light Gyns.

Section I.

TO RAISE THE GYN.

*Prepare to raise the gyn.**Lift.**Hook the tackle.**Raise the gyn.**Halt.*

"*Prepare to raise the gyn,*" 2 and 3, facing inwards, each place a handspike slantwise under the lower crossbar, close to the cheeks, and take a purchase to prevent them slipping; 4, 5, 6, 7, 12, and 13 stand to the cheeks near the head of the gyn; 8 passes a handspike through the prypole ring to 9, these Nos. stand with their backs towards the top of the gyn; having their hands next the prypole back under, their others back up.

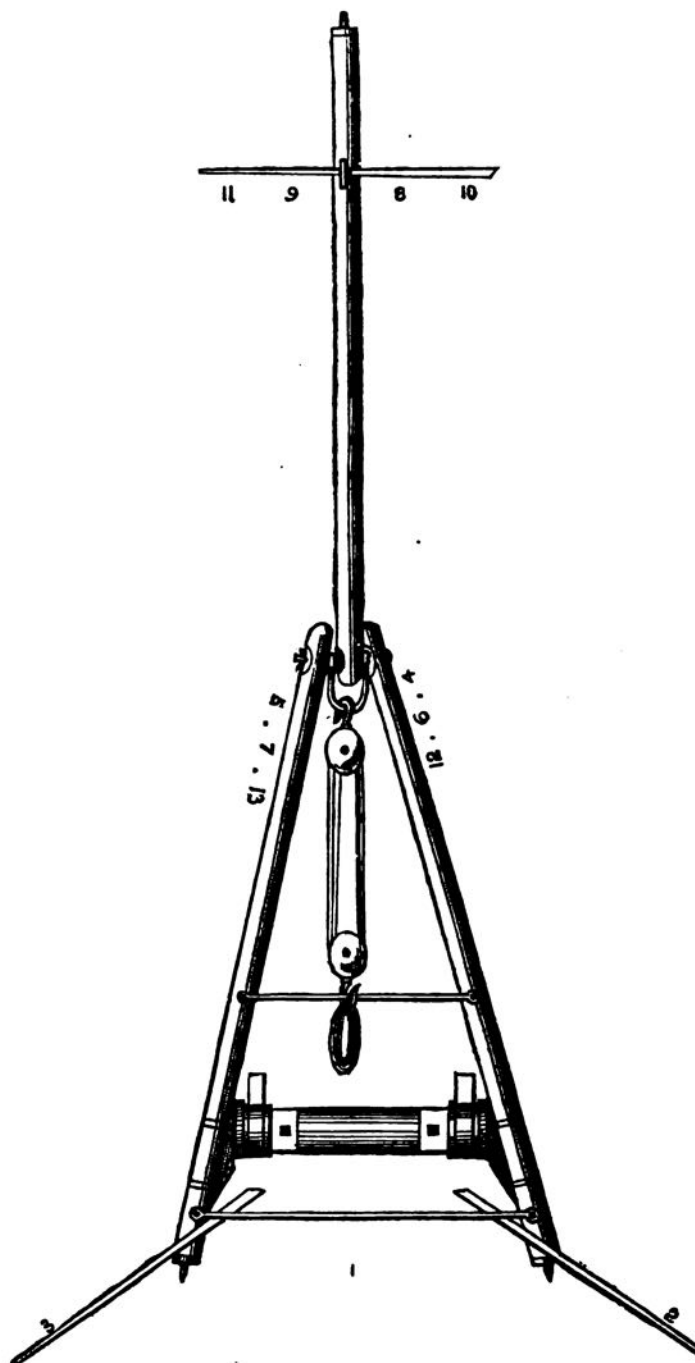
"*Lift.*"—The head of the gyn is lifted till high enough to be supported on the fid or a piece of skidding, whilst the tackle is being hooked.

"*Hook the tackle,*" 11 hooks the upper block to the shackle, assisted by 10, with the point of the hook towards the pryhole; the running end of the fall leading from the upper block. 10 brings the lower block under the gyn, and hooks it to the upper crossbar, assisted by 11, the back of the hook downwards; they then haul in the slack and place a half-hitch on the point of the hook with the fall, the bight of the latter being brought up below the crossbar; they then place themselves on the outside of 8 and 9, grasping the handspike, ready to lift. (Fig. 2.)

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16 and 18-foot Light Gyns.

Fig. 2.
Raising the Gyn.*



* In this the coil is shown round the hook ; this is not done, however, until the gyn has been raised.

16 and 18-foot Light Gyns.

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"Raise the Gyn," the prypole Nos. walk back towards the cheeks, which the remaining Nos., except 2 and 3, raise as high as they can, facing the windlass.

When the head is once rising, the Nos. should walk in quickly with the prypole.

"Halt," the prypole is allowed to rest on the ground at once. No. 1 should place himself in rear of the centre of the gyn, so as to see that the prypole is brought back opposite to the centre of the windlass.

TO PLACE THE GYN (Fig. 3).

Prepare to place the gyn.

Cheeks in, out, right, or left.

Lift.

Halt.

Prypole in, out, right, or left.

Lift.

Halt.

"Prepare to place the gyn," No. 1 places himself in rear of the centre of the windlass, so as to see that in moving, the prypole is kept within safe limits, right or left of the centre of the windlass. 2 and 3 each pass a lever under the windlass from the outside, close to the cheeks, to 4 and 5, who man them on the inside. 6 and 7 each pass a handspike under the windlass from the outside to 12 and 13 inside, the whole facing outwards:—that is, 2, 4, 6, and 12 to the right, and 3, 5, 7, and 13 to the left. 10 and 11 place the coil of the fall on the hook of the lower block.

"Cheeks in, out, right, or left." "Lift," the Nos. thus posted act according to the directions of No. 1.

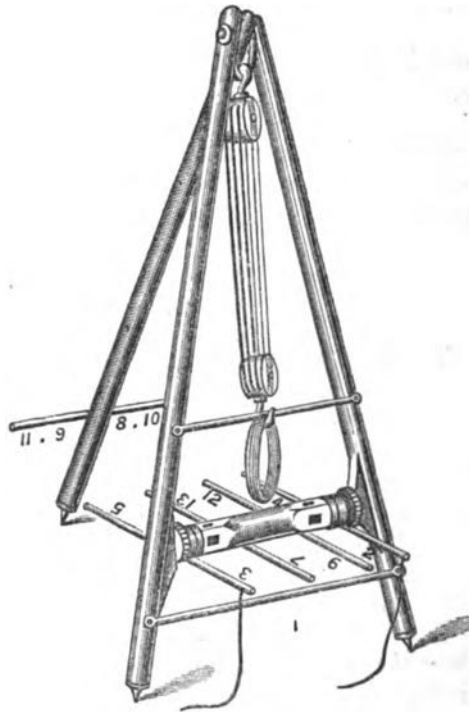
When lifting to the right or left the Nos. at the cheeks should face in the direction to which the gyn is to be carried.

"Prypole in, out, right, or left." "Lift," the position of the prypole is similarly altered by means of the handspike, through the prypole ring; 8 passes a handspike through the prypole ring to 9, double manned by 10 and 11.

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16 and 18-foot Light Gyns.

Fig. 3.
Placing the Gyn.



"Halt," the cheeks or prypole are allowed to come to the ground at once.

POSITION OF GYNS.

In Mounting or Dismounting Guns on Traversing Platforms.

If the gun is mounted on a platform, due to "A" or "B" pivot, run the carriage back to the stops, which will permit the gyn to be placed so that the rear block of the platform, when traversed, will pass the prypole. The space between the outside of the platform and the inside of the prypole should not be less than the width of the platform.

With platforms on racers having a "C" pivot, the gun must be run up or back to the stops, and the gyn placed so that after the gun has been raised, the carriage can be run up or back and the platform traversed, so as to admit of the gun being lowered parallel to the platform (*see also* p. 529).

With platforms on racers, having "D" or "F" pivots, the gun is run up until the muzzle (or fid, if one is used), being close to the inside of the parapet, can clear it in lowering, the gyn is then placed obliquely over the gun, the cheek furthest from the pivot close to the platform, so as to allow the greatest amount of traversing.

16 and 18-foot Light Gyns.

Section I.

TO CARRY A GYN WHEN RAISED.

Prepare to carry the gyn to the Right (Left, &c.)

Lift.

Halt.

"*Prepare to carry the gyn to the Right (Left, &c.)*," the prypole Nos. turn to the windlass, those at the windlass in the direction the gyn is to be carried.

"*Lift*," the whole gyn is raised and carried to the right, left, front, or rear, by the Nos. placed as above, No. 1 giving the word "*Halt*" when the gyn is in position.

In carrying to the *front* or *rear*, a drag rope should be made fast close under the ring of the prypole and two turns taken round the windlass, the end being held on to or made fast.

The less the splay to the gyn given the easier it will be to carry.

TO PLACE THE TRUCKS OF A GYN.

The trucks are placed under the cheeks and prypole by No. 1, their inward edges being sunk if practicable, until the legs of the gyn are perpendicular to them.

The prypole must be secured to the cheeks by lashing ropes as near the ground as possible; this is done by 8 and 9.

TO RAISE A GUN BY A GYN.*

Pass the fall round the windlass and sling the gun.

Heave in the slack.

Shift the fall.

Work lever.

Stopper and shift the fall.

Unstopper.

High enough—Make fast.

Out levers.

"*Pass the fall round the windlass and sling the gun*" (fig. 4), 2, 3, 4, and 5 place themselves on the outside of the windlass, opposite to the iron sockets on their respective sides; 2 and 3, after the slack is hauled in, raise the sockets so that the levers can easily enter, 4 and 5, behind 2 and 3, holding the levers in their outward hands. 6, on the inside of the windlass, lifts the coil of the fall over the windlass; 7 receives it, and passes it back to him under the windlass. It is thus passed over and under until four turns are taken round the barrel; the turns are taken towards the right, when the fall of the tackle comes out on the left of the upper block, and towards the left, when the fall comes out on the right. When the four turns have been taken, 7 throws the running end of the fall to 8 and 9, who stretch it out, and 6 lays hold

* In this case a gun has been taken as an example, but any other weight would be treated in the same way.

(A. M.)

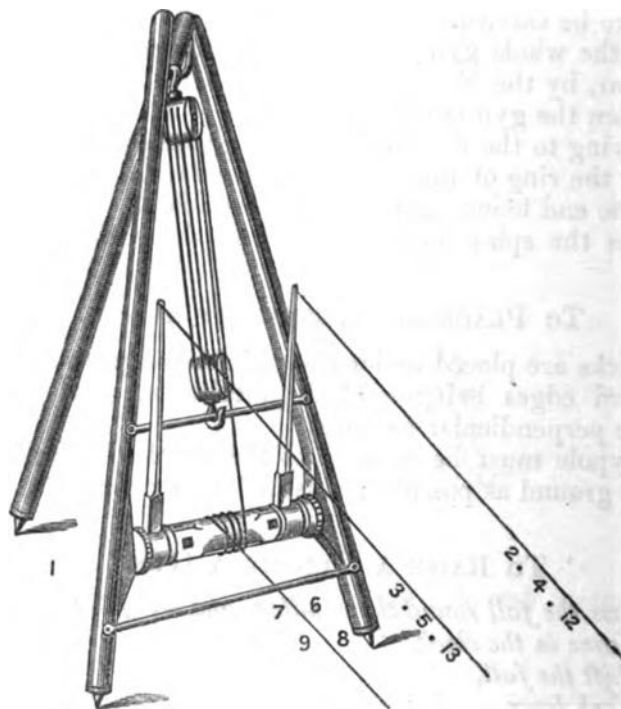
Section I.

16 and 18-foot Light Gyns.

of it a little in advance of 7. The whole nearly fronting the gyn. 10 and 11 cast off the coil of the fall and let the tackle hang, then fix the sling or lashing in the manner hereafter described (page 488), they also fix drag-ropes on the breech and muzzle.

Fig. 4.*

Working the Levers.



"*Heave in the slack,*" 6, 7, 8, and 9 heave in as much as possible, then hold on; after which 2 and 3 work the sockets.

"*Shift the fall,*" 6 eases the turns of the fall, and shifts them, as directed, to the end of the barrel of the windlass, 7 holding on above the windlass.

"*Work levers,*" 2 and 3 receive the levers from 4 and 5 and insert them in the sockets, then, assisted by 4, 5, 12, and 13 haul down until the small ends touch the ground; the levers are then, without any pause, thrown up as before, hauled down, and so on.

When the fall has worked to the end of the barrel, it must be *stoppered and shifted.*

"*Stopper and shift the fall.*"—2 and 3 withdraw their levers. If no stopper is available, No. 6 walks forward, moving hand over hand on the fall, places one foot against the lower crossbar, and holds on. 8 and 9 pass the running end of the fall from below

* In the wood-cut the returns round the windlass are shown as taken on the left of the running end of the fall, it is, however, usual to reeve gyn tackles with the running end of the fall coming off on the left of the upper block, in which case the returns round the windlass should, as stated above, be taken to the right.

16 and 18-foot Light Gyns.

Section I.

upwards three times round the foot of the cheek farthest from the end of the windlass on which the turns are; then bring the end up in rear of the crossbar in front of the windlass, and hand it to 2 and 3, who make a stopper hitch on the fall, close above the windlass, seizing the end to the fall with a piece of spun yarn. 8 and 9 haul in the slack between the hitch and foot of the cheek, tightening the turns round the foot, and hold well on. 6 then eases off the fall from the windlass until the weight is thrown on the foot of the cheek, when he shifts the turns.

If the operation of shifting is required to be performed often, a gasket should be placed round the cheek, below the lower cross bar on the side on which the running end of the fall comes off, to be used as a stopper.

"Unstopper."—The levers are worked, or, with light weights, the fall eased off by 8 and 9, until the strain is transferred from the foot of the cheek back to the windlass. 2 and 3 then cast off the stopper hitch; 8 and 9 clear the fall from the foot of the cheek, and the levers are worked as before.

"High enough," "Out levers," "Make fast."—As soon as these orders are given, 2 and 3 withdraw their levers, and place them on the ground outside the cheeks. Nos. 7, 8, and 9 let go the fall, No. 6 moves in, hand over hand, towards the windlass until his right hand is about 12 inches from the barrel; he then halts, presses down the fall with his right hand, and with his left passes a bight of it between the windlass and lower crossbar, assisted by 7, then passes his left hand under the same bar, brings the bight out under it, takes a firm grasp of the fall with his left hand and hauls it upwards. With his right hand he then passes a long bight of the running part of the fall above the windlass, inside of the return which is between the windlass and upper crossbar, hauling the bight well through. He then takes hold of the bight with his right hand, back upwards, and hauls it down with both hands until it is jammed between the fall and windlass, and finally makes a half-hitch with the bight round the whole of the returns of the fall, just below the windlass.

TO LOWER A GUN SUSPENDED BY A GYN.

Prepare to lower off round the windlass.

Lower.

Overhaul and unsling.

"Prepare to lower off round the windlass."—No. 6 carefully casts off the hitch he made on the returns, clears away the fall, places his right foot against the lower crossbar, and with his body thrown back holds on the fall, 7 stretching it to the rear.

(A. M.)

2 H 2

Section I.

16 and 18-foot Light Gyns.

"Lower."—6 eases off the fall hand over hand without jerks, and allows the gun to descend gently.

If the fall will not run, 6 eases it off by raising his hands; he must, however, take care not to ease off too quickly.

If that be not sufficient, he pushes the fall from him, easing the turns on the windlass with his left hand underneath, the other numbers holding on.

If the fall runs too freely, 6 checks it by lowering his hands and pressing it against the windlass.

Guns over three tons should be lowered by means of the gyn levers, in the manner described for the heavy gyn, p. 482.

"Overhaul and unslung."—The gun is unslung, and the sling removed by the same numbers that slung it, 6 easing off the fall to facilitate the operation.

TO STRIKE THE GYN.

Prepare to strike the gyn.

Strike the gyn.

Unhook tackle.

"Prepare to strike the gyn."—10 hooks the lower block to the upper crossbar, and with 11 hauls in the slack, taking a half-hitch round the point of the hook. 6 and 7 take the fall off the barrel of the windlass, 6 lays it down on the right of the gyn; 2 and 3 use handspikes, as in raising; 4, 5, 6, 7, 12, and 13 stand facing their respective cheeks ready to receive them; 8, 9, 10, and 11 man the handspike placed through the prypole-ring.

"Strike the gyn."—The numbers at the prypole walk forward, keeping the foot close to the ground. The numbers at the cheeks step back towards the head of the gyn, supporting the cheeks as they descend, placing themselves so that they may be outside of the cheeks when lowered. 2 and 3 bear well against the lower crossbar with their handspikes to prevent the cheeks from slipping out. When low enough, *"Unhook tackle,"* 10 unhooks the lower block from the crossbar, 11 the upper block from the shackle, and together lay the tackle on the ground to the right of the gyn.

TO TAKE THE GYN TO PIECES.

Take the Gyn to pieces.

"Take the gyn to pieces."—Each number undoes the work which he performed in putting the gyn together.

18-foot Heavy Gyn.

Section I.

18-FOOT HEAVY GYN.

The detachment consists of 19 numbers told off as for M. L. gun drill.

TO ARRANGE STORES.

Arrange Stores.

"Arrange Stores."—The several parts of the gyn are brought and placed in a convenient position, ready to be put together.

The same numbers bring up the same stores as for the lighter gyns, except 8 brings up an 8-ft. lever for the prypole ring, 10 and 11 a tackle, consisting of two treble 15-inch Bothway's blocks rove with 5-inch fall, 18 fathoms, also a single 8-inch* Admiralty block and 7 fathoms of 2-inch rope to be used as a whip on the top of the prypole, 12 and 13 a sling according to the gun or weight to be raised.

7-ft. handspikes are also brought up in place of 6-ft.

The stores are laid down as with the lighter gyns.

The detachment then falls in, in rear, facing to the front.

GENERAL DUTIES.

The duties of the detachment are nearly the same as with the lighter gyns. No. 1 has an additional duty to perform in holding on to the check rope in lowering and raising the gyn, and 10 and 11 have to hook and arrange the whip for raising the gyn tackle.

The numbers from 12 upwards assist those to whom they respectively correspond, *e.g.* :—

12 assists 2,

13 assists 3, &c.

TO TAKE POST ON THE GYN.

As with the lighter Gyns.

TO PUT THE GYN TOGETHER.

Put the gyn together.

Place the windlass.

Hook block for whip.

"Put the gyn together."—2 unkeys the upper crossbar, and passes it to 3; 3 unkeys the lower crossbar and passes it to 2; 4, 12, and 14 hold up the top of the right cheek; 9, 18, and 19 the top of the prypole; 5 holds up the shackle, and 8 passes the bolt through the right cheek, shackle, and prypole; 5, 13, and 15 now hold up the left cheek, 8 drives the bolt through, and 9 keys up; 2 and 3 steady the cheeks with the crossbars whilst the head is put together, Fig. 5.

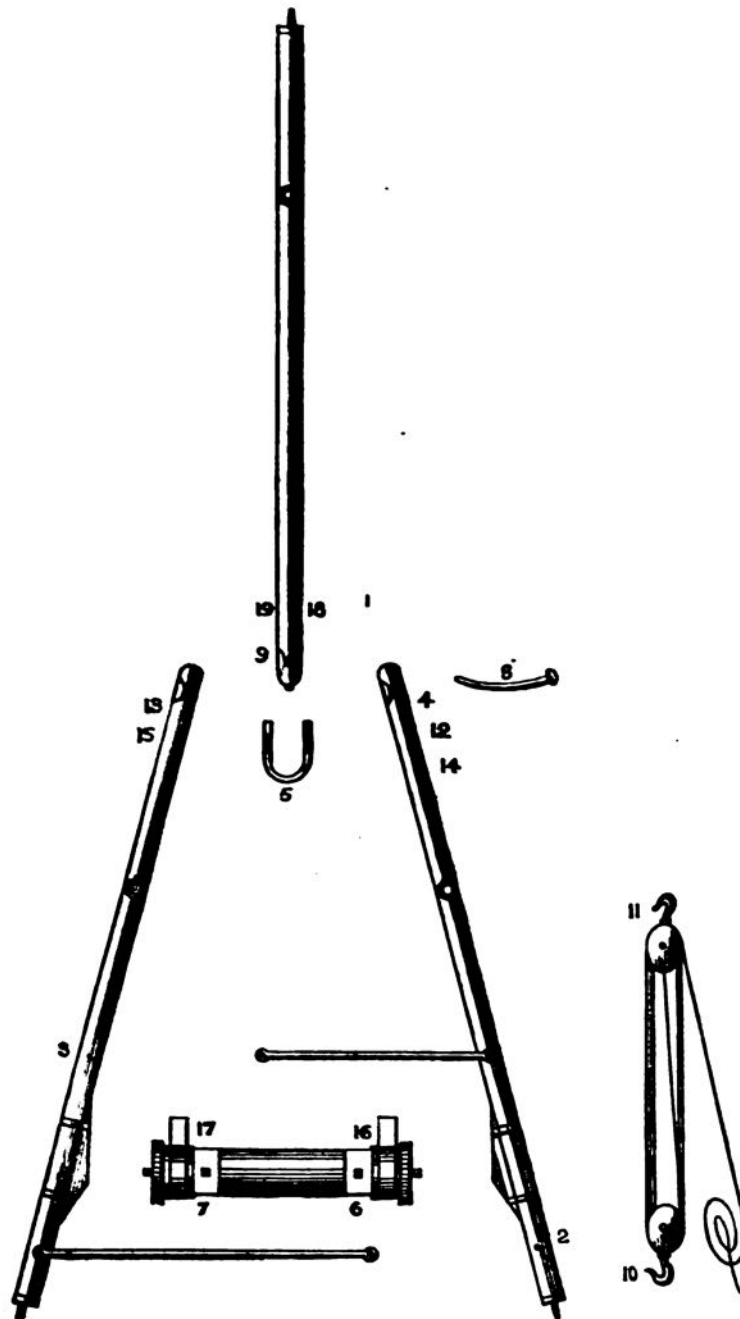
* 8-inch block not required with forked prypole gyn.

Section I

18-foot Heavy Gyn.

Fig. 5.

Putting the Gyn together.



18-foot Heavy Gyn.

Section I.

"Place the windlass."—6, 7, 16, and 17, place the windlass, 2 and 3 pinching in the cheeks, and raising them by applying handspikes under the spikes of the feet until the gudgeons are in the holes.

"Hook block for whip."—10 hooks the block of the whip to the top of the prypole, back of the hook down, and litches the fall to the upper crossbar; 10, 11, 18, and 19 bring up the tackle and place it alongside the gyn, the upper block in line with the centre of the cheeks.

TO RAISE THE GYN.

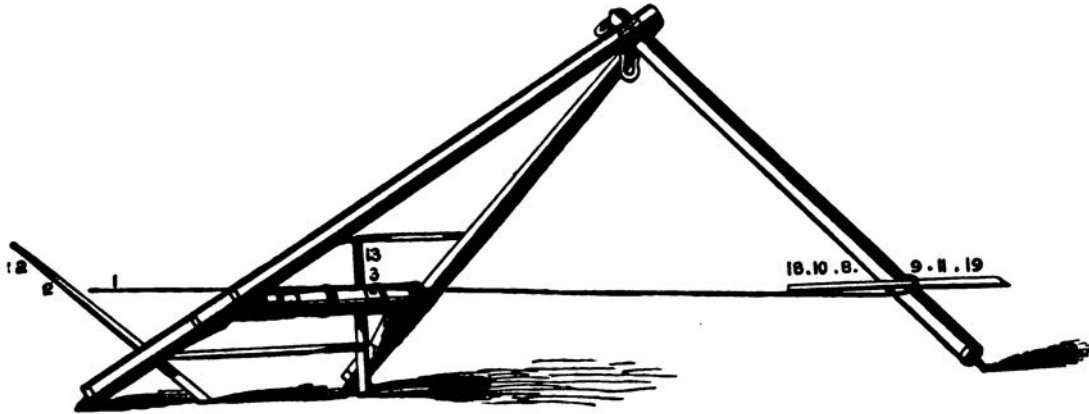
Prepare to raise the gyn.

Raise the gyn.

Halt.

"Prepare to raise the gyn."—2 and 3 each place a handspike under the lower crossbar, standing outside the cheeks; 12 and 13, if necessary, on their respective sides assist them in preventing the cheeks slipping to the rear, Fig. 6.

Fig. 6.
Raising the Gyn.



No. 1 bends two drag-ropes together, makes fast one end of them to the prypole below the ring, takes a turn with the other end round the windlass and holds on in rear, taking in the slack as the gyn rises, assisted by 4, 5, 6, 7, 14, 15, 16, and 17, who in succession man the rope as the head of the gyn gets above their reach.

8 passes the 8-foot lever through the prypole ring to 9, double-manned by 10 and 11, 18 and 19.

4, 6, 14, and 16 lift at the head of the right cheek.

5, 7, 15, and 17 lift at the head of the left cheek.

"Raise the gyn."—The prypole numbers walk back towards the cheeks, forcing in the prypole; the numbers at the head lifting, and those at the feet preventing them from slipping outwards.

"Halt."—The prypole is allowed to rest on the ground.

Section I.

18-foot Heavy Gyn.

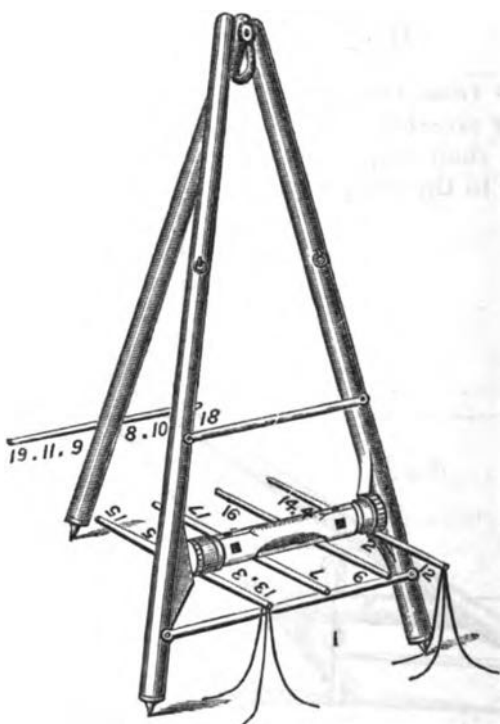
TO PLACE THE GYN.

Words of command as with lighter gyns.

"Prepare to place the gyn."—2 passes a gyn lever under the windlass, close to the right cheek, to 4; this lever is manned by 2, 4, 12, and 14. 3 in the same way passes a lever to 5; this is manned by 3, 5, 13, and 15. In both cases the lowest Nos. are next the windlass, and 2, 12, 3, 13 on the outside; 4, 14, 5, 15 on the inside, Fig. 7.

Fig. 7.

Placing the Gyn.



6 and 7 each pass a handspike from the outside of the windlass to 16 and 17 on the inside, as near the levers of 2 and 3 as possible without inconveniencing the Nos. on them.

In moving the cheeks in or out, the even Nos. lifting them face to the right, and the odd Nos. to the left; in moving them right or left the Nos. face right or left.

The prypole is moved by the Nos. posted, as in raising the gyn.

TO PLACE THE TRUCKS.

"Place the trucks."—The trucks are placed by No. 1, the cheeks and prypole being lifted by the Nos. told off to them.

The feet of the cheeks and the prypole are then lashed together by 8 and 9.

18-foot Heavy Gyn.

Section I.

TO HOOK THE TACKLE.

"Hook the tackle."—11 fastens the end of the whip to the shackle bolt of the upper block; the tackle is invariably to be raised by means of the windlass, and not by hand, having been previously overhauled, so that the weight of the lower block will not have to be taken; 10 and 11 mount up on a handspike placed through the rings fitted for the purpose on the cheeks near the head of the gyn to guide the hook as necessary, afterwards coiling the fall round the head of the prypole.

In the case of gyns with forked prypole, the hoisting rope attached by two half hitches runs from front to rear over the head bolt of the gyn, no block being used to hoist the tackle.

With gyns fitted with shackle the hoisting rope should be led from the single block on top of the prypole through the shackle, and then be made fast to the upper block of the gyn tackle in the following manner, which is applicable to all 18-ft. heavy gyns.

The standing end of the hoisting rope should be made fast with two half hitches to the shackle bolt of the upper block of the gyn tackle on the side opposite to that on which the running end of the gyn tackle fall comes off; by allowing the hook and shackle of the block to fall over towards the running end of the gyn tackle fall, room will be obtained to get at the shackle bolt. If made fast otherwise, difficulty will be experienced in hooking the tackle.

Gyns with forked prypole require to be splayed considerably to allow of the tackle being hooked over the head bolt.

TO PASS THE FALL ROUND THE WINDLASS AND SLING THE GUN.

Pass the fall round the windlass.

Sling the gun.

"Pass the fall round the windlass" and *"Sling the gun,"* as with the light gyn, except *five* turns are to be taken round the windlass. In using an *iron* gyn, the running end of the fall must lie *outside* the cross bars.

TO RAISE A GUN BY A HEAVY GYN.

Words of command as with lighter gyns.

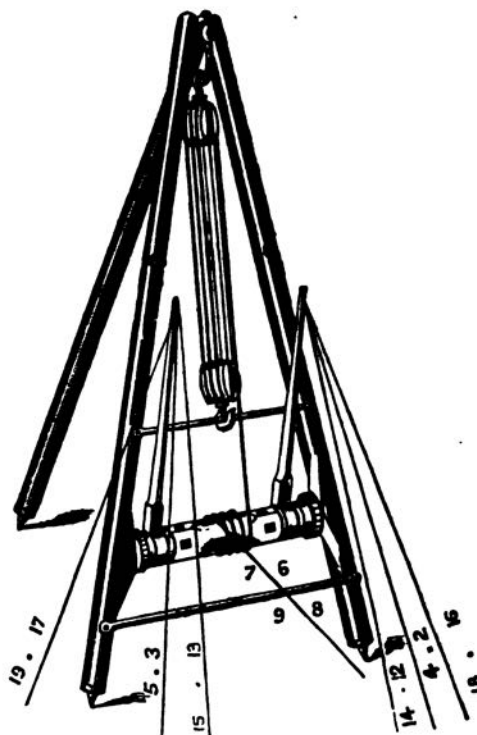
In raising the gun 6, 7, 8, and 9 hold on to the end of the fall in order; the even Nos. on the right, odd on the left, Fig. 8.

Section I.

18-foot Heavy Gyn.

Fig. 8.

Working the Levers.



2, 4, 12, 14, 16, and 18 work the right lever.
 3, 5, 13, 15, 17, and 19 work the left lever.
 10 and 11 steady the gun with drag-ropes.

TO LOWER A GUN SUSPENDED BY A HEAVY GYN.

*Prepare to lower.**Bear down.**Unpawl.**Ease off.**Pawl.**Bear down, &c.**Over-haul and unsling.*

"Prepare to lower."—No. 1 places himself outside the right cheek ready to attend to the pawl; 7 places himself outside the left cheek for the same purpose; they lift the ratchet pawls and the levers are brought nearly horizontal.

No. 1 gives *"Bear down,"* and when the weight is off the pawls gives *"Unpawl,"* when the pawls are lifted by Nos. 1 and 7.

"Ease off."—The levers are allowed to rise gradually, until nearly perpendicular, when *"Pawl"* is given, and Nos. 1 and 7

18-foot Heavy Gyn.

Section I.

drop the pawls; they then lift the ratchet pawls, 2 and 3 assisting by pushing up the levers; and thus the operations are continued until the gun is lowered.

Weights over 5 tons should invariably be lowered by working the levers as above described.

"Over-haul and unsling."—The gun is unslung and the sling cast off and removed as before.

TO STRIKE THE GYN.

Lower the tackle.

Prepare to strike the gyn.

Strike the gyn.

"Lower the tackle."—10 and 11 mount up as before, the remaining Nos. haul the hook out of the shackle, then lower away:* 10, 11, 18, and 19 remove the tackle from under the gyn, or receive it on a handcart.

"Prepare to strike the gyn."—8 and 9 unlash the feet and No. 1, with two drag-ropes bent together as before, makes fast one end to the prypole, takes two turns round the windlass, and holds on in rear. The remaining Nos. place themselves as in raising the gyn.

"Strike the gyn," the Nos. at the prypole walk forward, keeping the foot of it close to the ground; the Nos. at the cheeks step back towards the head of the gyn, supporting the cheeks as they descend; 2, 3, 12, and 13, bearing well against the lower crossbar with their handspikes, No. 1 regulating the descent of the gyn by means of the check rope.

TO TAKE THE GYN TO PIECES.

As with lighter gyns.

* If the hoisting rope has been made fast, as previously described, the upper block of the gyn tackle will unhook itself on the weight being taken.

Section II.

Gibraltar Gyn.

Section II.—Gibraltar Gyn.

The *Gibrallar gyn* may be used for mounting and dismounting ordnance on and from standing carriages in situations where a triangle gyn could not be conveniently used. It weighs 10½ cwt., and can support 3 tons with safety.

The detachment consists of 7 Nos., told off as for M.L. gun-drill.

TO ARRANGE STORES.

Arrange stores.

The gyn is moved by means of drag ropes hooked to the staples of the front or rear axletrees by 6 and 7. It can be drawn short distances over hard level ground by its own detachment.

The rear of the gyn is the part where the windlass is fixed.

"*Arrange stores.*"—The stores are brought up as follows:—

No. 1. A piece of spun yarn.

2 and 3. Two lashings 3½ fathoms 2½-inch tarred rope, and a handspike each.

4. One special iron triple block, with bar of iron attached, and a handspike.

5. A small gasket and a handspike.

6. A fall of 3½-inch white rope, eight fathoms long.

7. Two drag-ropes.

The detachment falls in three paces in rear of, and fronting the gyn.

GENERAL DUTIES.

No. 1 Commands.

Left side.

3. Heaves round the windlass, assists 7 to sling the gun.

5. Assists to hold on the fall, stoppers and unstoppers it.

7. Assists 6.

Right side.

2. Heaves round the windlass, assists 6 to sling the gun.

4. Holds on the fall, makes it fast, and lowers the gun.

6. Reeves the tackle, slings, unslings, and steadies the gun.

TO TAKE POST ON THE GYN.

*Take post on the gyn.**Right turn.**Double, march.*

"*Take post on the gyn*"—"Right turn"—"*Double march.*"—The detachment wheels to the left, and the ranks open out. 2 and 3 halting one pace in rear of their respective axletree arms, the whole one pace from each other and covering.

Gibraltar Gyn.

Section II.

TO PLACE THE GYN.

*Prepare to place the gyn.**Place the gyn.*

"Prepare to place the gyn."—The gyn is brought close to and across the direction of the axis of the gun. 6 and 7 unkey the bar which connects the uprights at their lower part, and secure it out of the way.

"Place the gyn."—2 and 3 lift at each end of a handspike passed through the loop of the front upright beam; 4 and 5 on the inside, and 6 and 7 on the outside of the rear axletree, man a handspike passed through the large wheel. In this manner the gyn is brought over the gun, until the centre sheave in the crossbeam is directly above the centre of gravity, the direction of the crossbeam being at right angles to that of the axis of the gun.

TO REEVE THE TACKLE.

Reeve the Tackle.

"Reeve the tackle."—5 holds the triple block directly under the sheaves of the crossbeam. 7 passes the running end of the fall from the rear to the front through the staple in the crossbeam, until the crown end touches the staple. He then passes it through the left-hand sheave of the block, still working in the same direction, to 6, by whom it is passed round the left-hand sheave of the crossbeam. It is then passed through the block by 7 again, and so on, by the two Nos. alternately. When the tackle is fully rove, 6 passes the running end through the leading sheave to 4, who hauls the fall through, passes it under the windlass from the outside, and takes three turns round the barrel with it, working from left to right.

TO SLING THE GUN.

*Prepare to sling the gun.**Sling the gun.*

"Prepare to sling the gun."—If the gun is mounted, it must be depressed. 6 and 7 lay the lashings on the gun with their outward hands, and adjust the suspending bar on the upper surface of it in the direction of the axis, with its block directly over the centre of gravity.

"Sling the gun."—6 and 7, assisted by 2 and 3, pass the lashing three times round the gun and the suspending bar, hauling well taut, and taking care that the turns of the lashings be further apart on the under than on the upper surface of the gun.

Section II.

Gibraltar Gyn.

TO RAISE A GUN.

*Haul in the slack.**Heave round the windlass.**Halt.**Stopper the fall.**Shift the fall.**Unstopper.**Heave round the windlass.**High enough.**Make fast.*

"Haul in the slack."—5 hauls in the slack of the fall, and 4 shifts the turns to the right of the windlass.

"Heave round the windlass."—2 and 3 work the windlass until the fall requires shifting, 4 holds on the fall, 5 assists to hold on and coils it.

"Halt, Stopper the fall."—5 makes a stopper hitch round the fall with the stopper, and holds on.

"Shift the fall."—4 eases the turns on the windlass, shifts them to the right, and hauls taut again.

"Unstopper."—5 unstoppers the fall.

At *"Heave round the windlass,"* the windlass is again worked until the gun is high enough.

"High enough," "Make fast."—2 and 3 allow the windlass to come up to the pawl, 4 then makes fast the fall to the handle of it with two half hitches.

The carriage having been run under the gun, or away from it, as may be required, the gun is lowered and cast loose, each No. reversing the operations which he performed in lashing and raising it, except that lowering is always done by easing off round the windlass.

Slinging Ordnance.

Section III.

Section III.—Slinging Ordnance.

LIST OF GUN SLINGS APPLICABLE TO DIFFERENT NATURES OF ORDNANCE.

No.	Material.	Size and Length.	Use for which intended.
1.	Chain.. ..	1" link, 12 fathoms, page 491	Slinging 12-ton guns, when raised with one tackle.
2.	Chain.. ..	Breech and muzzle with triangular links. Vide page 550 and 2872, List of changes.	Slinging 12-ton guns, when raised with one tackle. Do. 18 and 25-ton guns, with two tackles.
3.	Rope, white *	12"—4' 4", fitted with thimble.	For cascable or half weight mark of 35 and 38-ton guns.
4.	Do. do. ..	9"—16' (should be issued with circular thimbles for use as required.)	For half weight mark of 35 and 38-ton guns, and for slinging 12-ton guns, when raised with one tackle.
5.	Do. do. ..	9"—7', fitted with thimble	For half weight mark of guns from 12 to 25 tons, when raised with two tackles.
6.	Do. do. ..	9"—3', fitted with thimble	For cascable of guns from 12 to 25 tons, when raised with two tackles.
7.	Do. do. ..	7"—14' 6"	Slinging 7-ton guns, when raised with one tackle.
8.	Do. do. ..	6"—12½'	Slinging guns of 5 tons and under, mortars, mortar beds, &c., &c., with one tackle.
9.	Iron-wire rope	3"	For use with "overhead" tackle for mounting guns, up to 25 tons, in casemates.

N.B.—Heavy dragropes may often be employed with advantage for slinging guns of about two tons weight and under, mortars, howitzers, carriages, &c., &c., the number of returns of rope employed in slinging being in proportion to the weight to be raised.

* A "special" 1½" white rope sling, 4' 4" in length, fitted with thimble, is supplied for use, with "special" gear used in landing 38-ton guns at circular iron forts (vide 3206, List of Changes in War Material), but may be used at cascable or half weight mark when occasion demands; if used under the cascable, the position of the thimble should be shifted to bring the splice at the side, on account of the small size of the cascable.

Section III.

Slinging Ordnance.

MODE OF APPLYING SLINGS.

No. 1. This chain sling is most easily applied in manner shown in Fig. 5, page 491.

No. 2. Full details regarding this sling and the different methods of applying it will be found in 2782, List of Changes.

Its chief use is with the 12-ton gun when being mounted or dismounted on or from dwarf traversing platforms by means of an 18-foot heavy gyn; the application of the sling in this operation will be found fully described further on at page 550. For lifting 18 or 25-ton guns with two tackles, the short rope slings Nos. 5 and 6 are much more handy.

No. 3. Instructions regarding the slinging 35 and 38-ton guns are given in the notes on moving and mounting those guns, and at page 663.

No. 4. Same remarks as with No. 3.

When this sling is used for lifting 12-ton guns it is most conveniently applied under cascable and chase as in Fig. 5, page 491.

Nos. 5 and 6. When raising guns from 12 to 25 tons with sheers, or two gyns, these are much the most handy slings to use; they are applied at cascable and half weight mark.

No. 7. It will be found most convenient to use this sling under the cascable and a fid in the bore of a 7-inch gun, as shown in Fig. 2, page 490.

No. 8. The following will probably be found to be the readiest way of using the sling with the different natures of guns, namely, when used with 80-pr. R.M.L. converted gun under cascable and chase, as in Fig. 5, page 491.

With 7-inch R.B.L. gun the same as 80-pr.

With 64-pr. guns whether W.I. or converted under cascable and fid in bore, Fig. 2, page 490.

With 40-pr. R.M.L. and R.B.L. guns under cascable and fid in bore, Fig. 2, page 490, or cascable and chase, Fig. 5, page 491.

For use with mortars, see page 493.

When drag ropes are used for slinging the smaller natures of ordnance, it is generally found most convenient to put them on as in Fig. 4 or 5, page 491.

In measuring chain slings the size of link given is the *diameter* of the iron of which it is made.

The length of a chain sling is its length when unshackled and laid out straight, whereas that of a rope sling is its length *on the double*, and its size the *circumference* of the rope in inches.

Chain slings possess the following advantages over rope, viz., their comparative indestructibility, and their being free from stretch, which is often important when mounting guns on dwarf traversing platforms with a gyn, in which case a rope sling may stretch so much that the tackle is chock-a-block before sufficient lift has been obtained, on the other hand rope slings are lighter and easier to apply except it be attempted to shorten them by twisting up, which is difficult and heavy work with a large sling

Slinging Ordnance.

Section III.

and distorts and injures the sling, the smaller slings used with lighter weights will stand twisting up better.

A rope sling, applied as in Fig. 5, p 491, may be shortened by inserting a couple of 6'' x 9'' oak skids between the returns of the sling and the upper surface of the chase.

A good rule for ascertaining what rope sling should be used with any particular nature of gun is:

Circumference of rope and calibre of gun should be the same in inches.

For example.—A 9-inch rope sling is suitable for a 9-inch gun, and a 7-inch rope sling for a 7-inch gun.

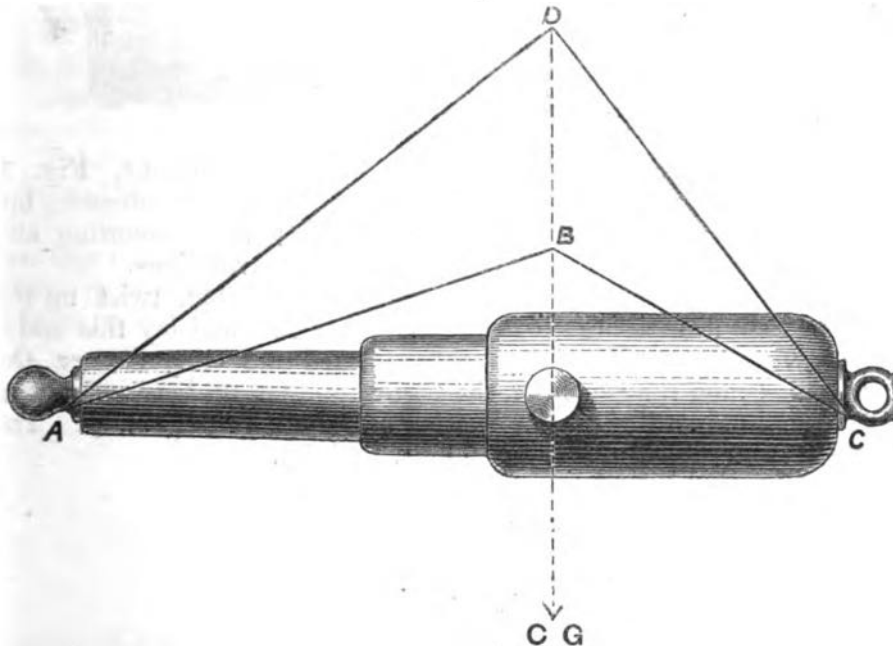
6-inch rope slings for all smaller natures: as a rule the one 12 feet in length will be found most suitable.

The chain sling, No. 2 in list, is very convenient when dismounting 12-ton guns with heavy gyn; and No. 1 might be usefully employed with either 7 or 12-ton guns when lift has to be economised, and lighter chain straps applied in like manner, with the smaller natures.

Rules for calculating the strength of rope and chain are given at pages 347 and 405.

It should be borne in mind that the nearer the point of suspension to the upper surface of the gun, the greater the strain on the sling.

Fig. 1.



For example, in Fig. 1, the strain on the shorter sling ABC is far greater than that on the longer sling ADC; in the former case the tension tending to raise the weight being small compared with that tending to compress the gun in the direction of its length. The strain on the tackle lifting the weight is of course the same in any case.

(A. M.)

Section III.

Slinging Ordnance.

In extemporizing slings with rope or chain with a view to economise lift, these points should be borne in mind, as a comparatively light chain or rope might possess ample strength applied as a long sling, but prove insufficient as a very short one.

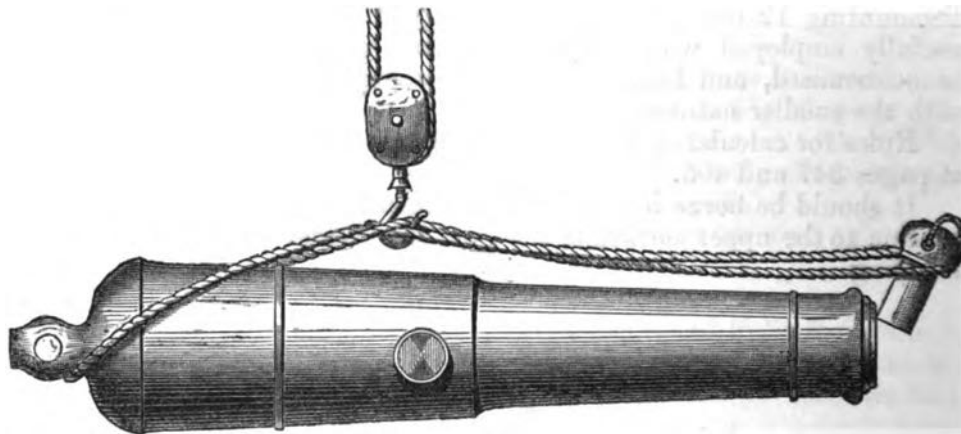
The various methods of slinging ordnance being closely connected with working gyns have been introduced into this part.

SLINGS FOR RAISING GUNS WITH ONE TACKLE.

When one lifting tackle only is employed guns may be slung by one of the following methods.

When suspended from cascable and fid in the bore, Fig. 2, applicable to rope slings.

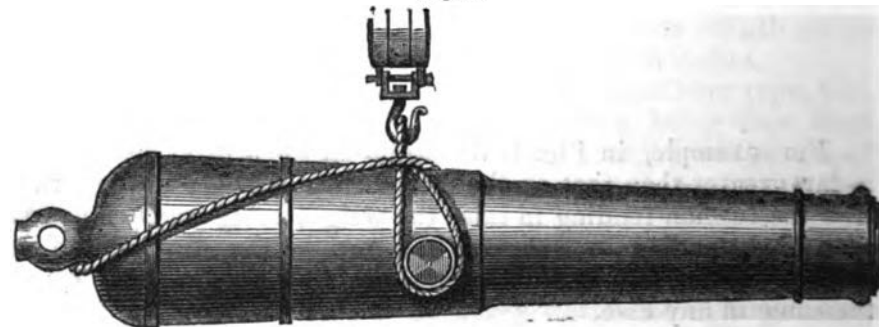
Fig. 2.



2. When suspended from cascable and trunnions, Fig. 3. Applicable to rope slings and the smaller natures of ordnance, but only when used under circumstances other than mounting and dismounting from the sling passing under the trunnions.

Pass one bight of the sling under the cascable, twist up the sling, then form a large bight at the other end, and lay this under the twisted part; the loops thus formed are slipped over the trunnions and the centre of the bight brought up between any of the twists according to the position of the centre of gravity. The block is then hooked into this bight. Fig. 3.

Fig. 3.



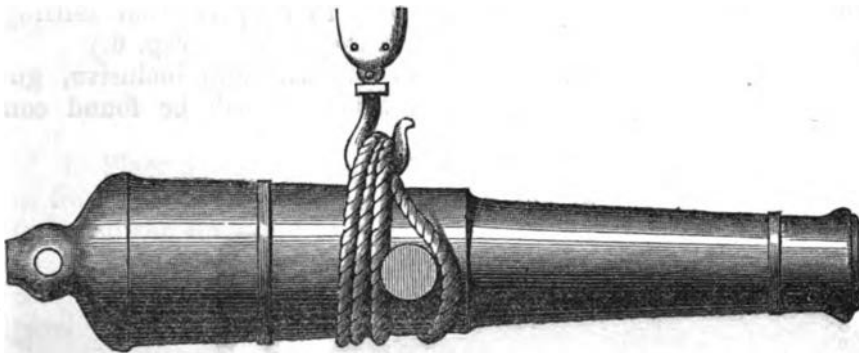
Slinging Ordnance.

Section III.

3. When the points of suspension are close in front and rear of the trunnions, Fig. 4. Applicable to rope lashing, and the smaller natures of ordnance, but not in mounting and dismounting, as the lashing would interfere with lowering into trunnion holes.

Lash the hook of the block to the gun over its centre of gravity, separating the returns underneath, making fast at the side. Fig. 4.

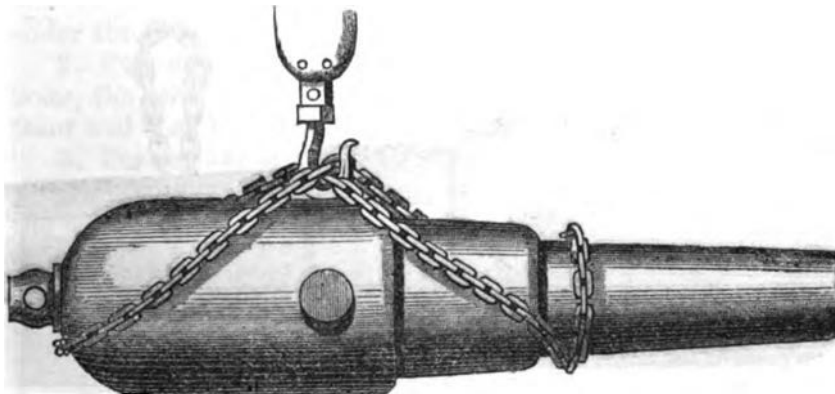
Fig. 4.



4. When the points of suspension are the cascable and chase, Fig. 5. Applicable to either rope or chain slings for guns up to 12 tons weight inclusive.

Take a turn with the bight of the sling round the chase of the gun, so that the returns lead from the under surface, then twist up the sling, and pass the bight at the other end underneath the cascable; hook the block so that the point of the hook is in the direction of the breech or muzzle, the returns of the sling forming a cross in the hook. Fig. 5.

Fig. 5.



(A. M.)

2 1 2

Section III.

Slinging Ordnance.

If a long length of chain is used, the ends should be secured with a reef knot.

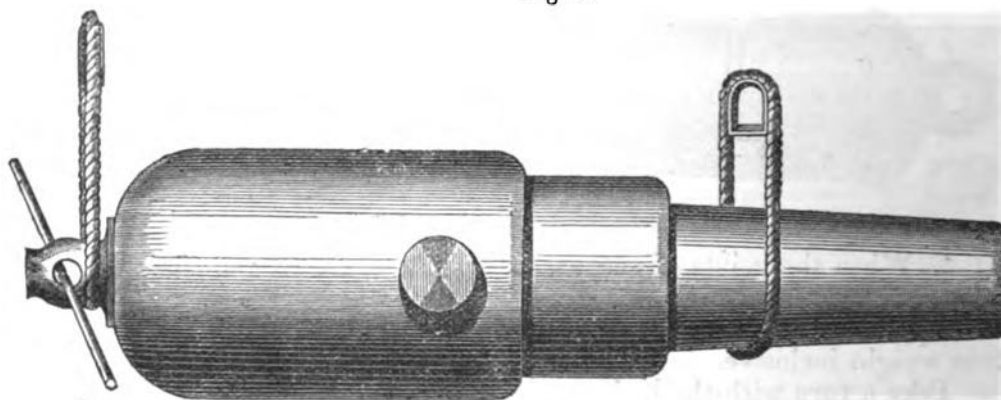
5. Points of suspension same as in case 4, but using the breech and muzzle slings described below, and at 2782 "Changes in War Stores."

SLINGS FOR RAISING GUNS WITH TWO TACKLES.

When raising guns by means of two tackles the slings should be placed as follows:—One at the neck of the cascable, with a small roller through the breeching loop to keep it from shifting, the other at the half weight mark on the chase. (Fig. 6.)

With guns from 7 to 25 tons weight, both inclusive, gun slings of 9-inch white rope, with thimbles, will be found con-

Fig. 6.



venient. That for the half weight being 7 and the one for the cascable 3 feet in length. They may, as a precaution, be lashed together to keep the muzzle sling from shifting, but nothing but extreme carelessness should cause the axis of the gun to get so much out of the horizontal as to induce this.

Fig. 7.



Slinging Ordnance.

Section III.

Fig. 7.—Two chain slings. One is placed under the cascable with a roller or iron bar passed through the latter to prevent the sling slipping off, the other is passed round the gun at the half-weight mark on the chase. If the ends of the chain as shown in Fig. 7, will pass through the cascable loop the iron bar will not be required, but the other mode is preferable, as straining the links of the chain less.

With the smaller natures of ordnance (5 tons and under) the hooks of the lower blocks of the hoisting tackles may be lashed to cascable and chase with drag ropes or stout lashing.

SLINGING MORTARS.

Mortars.

1. Place a bight of the sling on the upper surface of the mortar in front of the trunnions, lead the returns under the trunnions, twist up the sling and pass the other bight round the muzzle.

2. It is sometimes convenient to employ a gyn to dismount a mortar, as, for instance, in dismounting a 13-inch mortar, and placing it on a platform wagon, in which case the mortar may be slung as follows—

Remove capsquares, bring mortar vertical, remove coin, and lower mortar on to a large scotch or handspike, resting on front transom of bed.

Lash the hook of the lower block of the gyn tackle to the mortar by a heavy drag rope, using four returns for slinging, two of which should be placed about three inches in front of the centre of gravity of the mortar, and the other two a like distance in rear of it, the latter will come on the commencement of the curve of the breech.

Thus slung, the mortar will hang with its axis horizontal.

Mortar Beds.

1. Pass one bight of the sling under the rear horns, twist it up, bring it over the middle of the bed, then pass the other bight under the front horns.

2. Pass one bight of the sling under the right running up bolts, the other bight under the left running up bolts, bring the front and rear bights together over the centre of the bed.

3. Pass a skid or roller through the trunnion holes, the capsquares being on and keyed up, and lash the hook of the block to the centre of the skid or roller.

Section IV.

Crab Capstan.

Section IV.—Crab Capstan.

CRAB CAPSTAN.

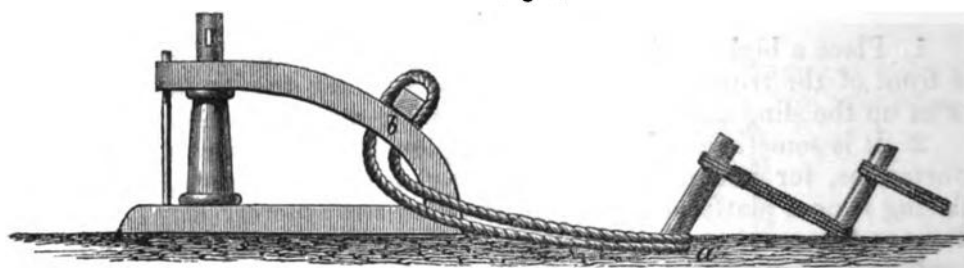
A crab capstan consists of a barrel and framework of wood and iron in which the barrel is supported in a vertical position.

It is worked by two capstan bars, which are passed through mortices in the head, each bar is 16 feet in length.

When used it is secured to pickets or other holdfasts.

The following will be found to be a convenient method of securing the capstan to the holdfast.

Fig. 1.



Take a 6-inch sling, pass it round the holdfast at "a," so that the middle of it lies at that point, bring the two bights of the sling up through the rear of the capstan at "b," and pass a short oak skid through both.

This method prevents the rear part of the capstan tipping up when the strain is taken, Fig. 1.

In Fig. 1 only one bight is shown at "b" (the one next the eye).

In good holding ground the ordinary 3, 2, 1 5-foot picket holdfast will be found sufficient to hold the capstan.

In preparing the capstan, one end (the running) of a rope is passed two or three times round the barrel from left to right, or "with the clock," the end coming off above the turns, the other (the standing) end being attached to the weight to be moved, or rove through a block, as the case may be.

Previous to working the capstan, the turns must be shifted to the top of the barrel and the slack heaved in by hand.

Three Nos. are the most that can work on each end of the bars, and two Nos. are required to hold on to the running end as it comes off, or more if the barrel and rope are wet and slippery.

If necessary, a gasket should be attached to the frame as a stopper.

When additional power is required, the capstan bars may be swifted, that is, ends of the bars lashed together with ropes for additional men to haul on. Three men at the ends of the bars, and two men on the rope between each bar, is the greatest

Crab Capstan.

Section IV.

number that can be employed at the capstan with advantage; two men being also required for the running end, as previously described.

If a crab capstan cannot be procured, a wheel may be employed, the nave serving as a windlass, as described below.

The mechanical power gained by a crab capstan is 13 to 1.

When fully manned with a strong detachment, it may be taken as a rule that a maximum strain of about two tons may be exerted at the barrel; the strain varying, of course, with the number, weight, and strength of the men working on the bars.

When additional power is required, a second capstan may be employed as a messenger behind the first, in the manner described at page 497.

If the running end of the rope leads upwards from the barrel, the returns of rope round it will be constantly slipping up and get jammed, or the capstan itself be lifted. In such cases it becomes necessary to make use of a leading block so as to secure a horizontal lead from the barrel of the capstan.

EXTEMPORIZED CAPSTAN.

A capstan may be extemporized by means of a siege or sling wagon limber in the following manner.

The limber selected should be one with a straight pintail, the sling wagon limber is most suitable. Remove wheels and shafts and secure body by pickets to the ground or to a holdfast, with the splinter bar next to the weight.

One of the wheels having been laid on the ground (dish uppermost), four handspikes are lashed firmly in two places to the shoulders of the spokes and felloes of the wheel, dividing its circumference into four equal parts.

Blocks of wood are placed under the splinter bar, in order to keep the limber horizontal.

The wheel is then placed on the pintail, dish up and one turn taken round the nave with the hauling rope, the running end coming off below.

The fall must be kept the same height as the nave, and also clear of the surface of the ground. A tackle may have to be applied to the running end of the fall for sufficient holding power.

Section V.

Iron Crab.

Section V.—Iron Crab.

An iron crab consists of a barrel, round which the rope or chain to be hauled on is passed; it is supported in a cast-iron frame, generally bolted to a wooden one.

The barrel is turned by winch handles fixed on either end of a spindle and a system of cog wheels, the handles being placed on at right angles to each other to avoid a "dead point." The spindle can be moved horizontally so as to throw the whole system into gear for slow or quick motion, by which means the power is increased or diminished.

The spindle is kept in its place by a pawl on the top of it.

A friction break, working on a smooth wheel on the spindle, is attached to the rear upper bar of the frame.

A pawl is also attached to the other end of the same bar; this acts on a ratchet wheel, on the same spindle as the driving wheel.

Previous to use the winch should be placed with the break handle towards the rear, the barrel at right angles to the direction of the strain, and secured by lashings to holdfasts in line with the sides of the frame.

An iron crab is never to be moved by means of the cross bars, for fear of bending them.

Those in the service are constructed to exert a strain of 2 and 5 tons (but only a few of the latter have been made as yet) when on the "slow" purchase, and about half those weights on the "quick" purchase.

Heavy weights should not be lowered by means of the brake lest it should get out of control, but by walking back on the winch handles.

Comparatively light weights may be lowered by means of the brake, which can be at all times employed with advantage in lowering, in conjunction with walking back on the winch handles, to ease the strain on the men manning the latter.

If lowering a heavy weight by means of the brake alone be attempted, and it is wished to check its descent, the necessary application of force to the brake lever is apt to bring it up with a jerk, which is liable to cause some of the gear to carry away and cause an accident.

When crabs are used to take in chain falls it is a good plan to serve the barrel round with $1\frac{1}{2}$ -inch tarred rope to enable the chain to bite, otherwise the chain will surge off round the barrel.

Proper lubrication of the gear is at all times essential.

In the latest pattern winches the gearing is so arranged that the handles have not to be shifted when the purchase is altered from single to double, and the handles are lengthened to admit of eight men working on them.

The ordinary service crab (crab iron, double-purchase, 2 tons), though only constructed to exert a strain of 2 tons at the barrel,

does this with ease (*i.e.*, when the men on the handles are making light work of it); if, therefore, it be strongly manned, a strain of between 3 and 4 tons will be exerted, but it should be borne in mind that the crab was not constructed or intended for such a strain, so, if additional power be requisite, it should be obtained by using a "messenger" in the following manner:—

The second winch is secured on the same line and a little behind the first, and should be adjusted so that its barrel lies slightly lower than the barrel of the first winch; this may be effected either by putting planks or skidding (from 9 inches to a foot in depth) under the front winch, or by sinking the rear one to a corresponding depth, according to the nature of the ground.

A 6-inch parbuckle rope is then made fast with a stopper-hitch to the running end of the fall of the main tackle, close up to the snatch-block at the foot of the sheer spar, and passed under the barrel of the first and round that of the second winch the requisite number of times; both winches now heave round together and share the strain between them.

One winch holds on whilst the other stoppers and shifts the fall.

Should a second winch not be procurable a crab capstan may be used instead, but is not so convenient, as the fall is not always the same height from the ground.

Iron crabs when on wooden frames may be conveyed from place to place on drags, on which they can be readily placed by means of long skids, 14' x 8" x 8", and 6-foot ground rollers. When on the drag they should be lashed for security.

The 2-ton crab, single purchase, gives a power of 24 to 1.

The 2-ton crab, double purchase, 72 to 1.

The 5-ton crab, double purchase, gives a power of 46½ to 1.

The 5-ton crab, treble purchase, 140 to 1.

In working crabs an additional power of 40 per cent. must be applied at the handles, over and above the theoretical power, to allow for the absorption of useful power through friction.

Section VI.—Jacks, Lifting.

There are four descriptions of lifting jacks used for garrison service, namely:—

- 1.—Clerk's—screw.
- 2.—The rack and pinion.
- 3.—Haley's—screw.
- 4.—Tangye's—hydraulic.

1.—“Clerk's” screw jacks consist of a vertical screw, precisely similar to that of the elevating screw for siege service, worked through a metal nut in a cast iron conical box by means of a ratchet arrangement, lever, socket and key; it will lift with safety 5 tons.

2.—“Rack and pinion” consists of a vertical bar with teeth, and lifting jaw working in a block of elm. The bar is raised or lowered by a system of pinions and cog wheels turned by a winch on the outside; it will raise about 3 tons. It is rarely met with.

3.—“Haley's” consists of a powerful screw working vertically in a metal nut, with a ratchet collar fitted into a block of elm.

The screw is raised or lowered by means of a worm wheel working in gear with the ratchet collar, and turned by a winch on the outside; those issued vary in lifting power from 2 to 20 tons.

The more powerful Haley's screw jacks (those for 16 and 20 tons) will be met with, made wholly of iron, and fitted with a screw traversing arrangement, which admits of the jack being traversed to either flank whilst the weight is on it; this is often of great service, as enabling a heavy gun to be fairly centred over its carriage for lowering into trunnion holes.

It is most essential in working with screw jacks to observe that they are thoroughly clean, free from grit, and well lubricated; the work in raising a heavy weight with them is, at the best, slow and laborious, but should these necessary precautions be neglected, not only will the labour be greatly increased, but injury be inflicted on the gear.

In the operation of mounting guns in casemates by means of jacks alone, the Haley's screw jacks, with traversing arrangement, may be employed with advantage under the ends of the beam lashed across the cascable for traversing the breech and lowering, for their broad base gives them great stability, and from the fact that the rate of lowering is so easily regulated, no difficulty is experienced in keeping the beam horizontal.

TANGYE'S HYDRAULIC JACK .

Fig. 1.

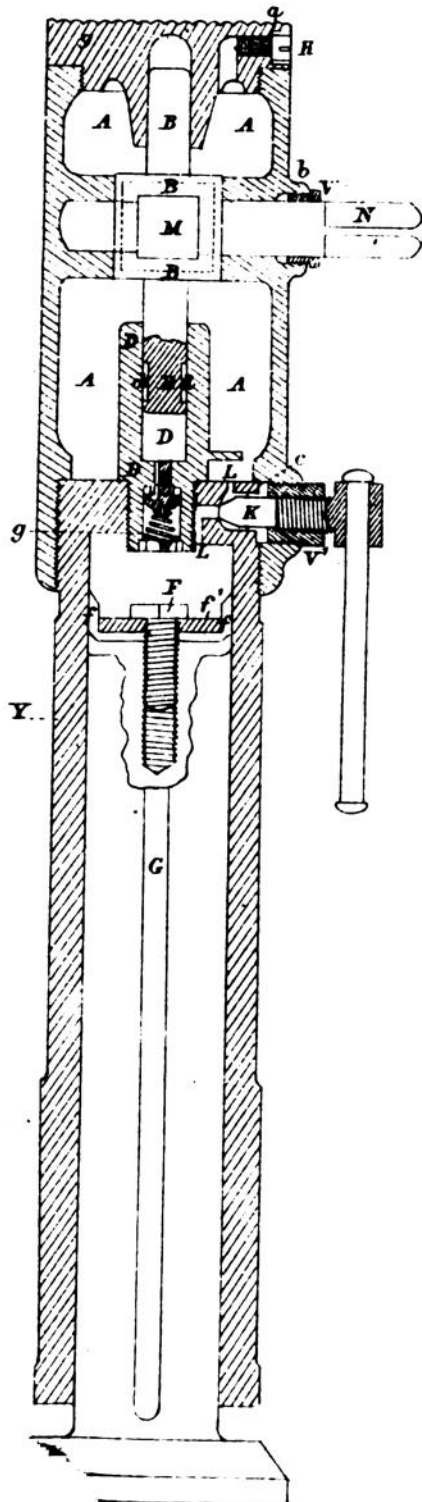


Fig. 2.

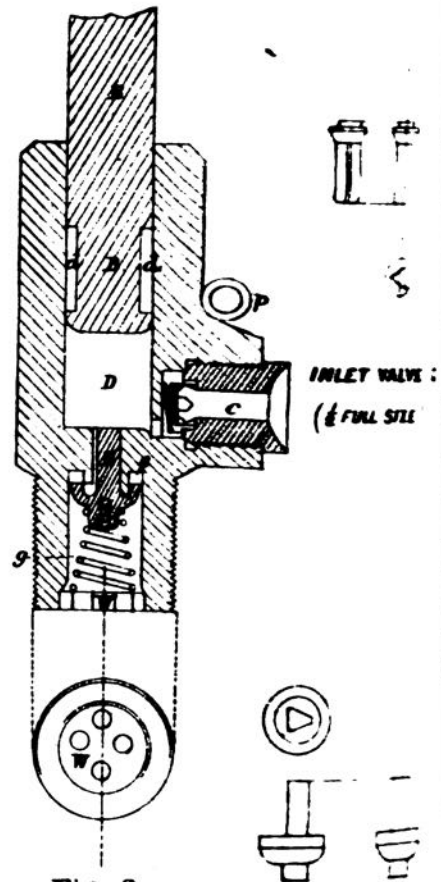
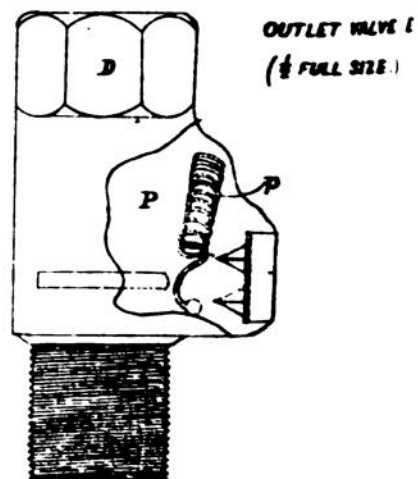


Fig. 3.



Jacks, Lifting.

Section VI.

They are not liable to get out of order; in this they possess a decided advantage over hydraulic jacks, yet from their slow action, and the great labour required in working them, they are very inferior to the latter for general purposes, especially for *lifting* heavy weights.

Hydraulic jacks to raise weights varying from 10 to 30 tons are used in the garrison service.

4.—“Tangye’s hydraulic” consists of a cylinder Y, ram G, and reservoir A, fitted with a small pump in the centre, with an inlet and outlet valve, worked by a lever on the end of a spindle N at the side of the reservoir. To lift a weight, the screw on the side of the reservoir is tightened, in doing which much force should not be used, the air-hole screw is loosened, and the lever worked up and down, which forces the water down on the top of the ram, and raises the cylinder. To lower, ease the screw V at the side of the reservoir, when the cylinder will descend. For further information *vide* “Treatise on Military Carriages, 1876,” R.C.D.

Should it be desired to lower very gradually, unship the handle of the jack, which, indeed, should always be done before lowering, and *gently* tap the handle of the side screw with it, increasing the strength of the blows until the screw begins to move; by this means the rate of lowering can be regulated to a nicety.

In a recent pattern 20 and 30-ton jack, the side screw for lowering has been done away with, the lowering being effected by moving the jack handle a little outwards on its spindle, thereby enabling it to pass a stop on the side of the jack, and so make a longer down stroke, which causes the pump plunger to press on and open a valve at the head of the ram, and so allow the water to flow back into the reservoir, and lower the jack.

Tangye’s jacks have been reported as liable to get out of order, the probable causes are—

1. Delicacy of construction.
2. Wear and tear.
3. Want of proper treatment.

With regard to the first, a certain amount of delicacy of construction is inseparable from all such machines, the taking to pieces, examination and repair of these jacks should therefore never be allowed to be undertaken by any but properly instructed persons, or the machine may be irretrievably ruined.

Wear and tear—The extreme pressure induced in working, causes of necessity a greater amount of wear and tear of valves, seatings and packing than might perhaps be expected; this is unavoidable. The leather packings require frequent renewal.

Want of proper treatment—The following are the main points to be observed in the care of hydraulic jacks.

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Jacks, Lifting.

None but the *purest water* should be employed for filling, as the smallest particles of dirt will cause escape round the valves.

The water used should be mixed with a third part of methylated spirits to check corrosion and guard against freezing. The filling hole is in the head. Before use see that the jack is full or nearly so, that the air-hole screw is loosened, that the side screw in the lighter jacks is screwed up: in doing this avoid using much force.

The jack should not be flung about or subjected to violent blows or shocks; it should always be kept filled whether in store or in use.

In cold weather if, on an emergency, water unmixed with spirits is used for filling, the jack should be kept in a warm place to prevent the water freezing.

Jacks should be kept as clean as possible, and worked occasionally at regular intervals to keep them in working order.

The heavier natures of jacks are fitted with a portable foot of cast iron secured by screws to give increased base, and will in future be fitted with handles for convenience in carrying and placing in position.

For transport the filling hole screw in the cap or head is tightened, the jack having been previously run down.

A few men properly instructed in the care, examination, and simple repairs of these valuable machines, are of the greatest service in garrison batteries when heavy work is going on.

The jacks should always be placed and worked by careful and intelligent men, who have been properly instructed in their use.

In raising heavy weights the jacks should stand perfectly upright on a hard and level surface; fir skids are not suitable for standing jacks on, being too soft, but good oak skids answer well.

The iron head or claw of the jack should not be allowed to come into contact with iron in lifting, but a thin piece of wood or a little hemp waste be interposed to avoid a slip.

Long, slow strokes of the handle are best. Short, jerky strokes should be avoided. Always follow up closely under a weight, as it rises with scotches and skidding, and in lowering stand by to scotch up and avoid having much air space under the weight. Never get the axis of a gun much out of the horizontal, otherwise there will be a tendency to slip or lurch to front or rear. About 3° inclination may be taken as a safe limit of slope.

Neither the jacks nor their supports should be struck whilst the weight is on them. Always, if possible, have spare jacks to fall back upon.

When a gun is resting on skidding it is often a convenience to apply a jack at an angle under the muzzle to cut or slew it a few inches to a flank, but it should be borne in mind that if the jack be subjected in the operation to a heavy strain (say one approaching

Jacks, Lifting.**Section VI.**

the limit of its maximum working strain), the ram is liable to become bent, and the jack to be thus rendered unserviceable.

The advantages obtained by the use of hydraulic jacks in heavy operations are very great, they may be briefly stated to be—

1. The ease and rapidity with which they raise the heaviest weights.

2. The small space required to work them in.

3. Their handiness and portability.

Their value to the artilleryman being so great, he should spare no pains to maintain them in proper working order.

Section VII.

Sling Wagon.

Section VII.—Sling Wagon.

There are three descriptions of sling wagons in the service, namely—

1. Sling wagon, wood, Mark I., with cast-iron fittings on the windlass, to carry $4\frac{1}{2}$ tons.
2. Sling wagon, wood, Mark II., with wrought-iron fittings on the windlass, to carry 6 tons.
3. Sling wagon, iron, Mark I., to carry 7 tons.

Besides the above a few sling wagons were constructed for weights of 12 and 23 tons, but no more will be made, and those in store will be retained for use in arsenals.

The windlass for the first three is fitted with two sets of ratchet wheels. Those at the extreme ends of the windlass, called windlass ratchets, are for the reception of the standing pawl on the frame or brackets, which hold the windlass while fresh purchases are being taken; the others, called the socket ratchets, are to enable the moveable pawls to take a purchase when the windlass is to be worked. The sockets are moveable iron mortices, attached by flanged iron rings to the windlass. To the sockets pawls are fitted, which act upon the ratchets. The flanged rings must be kept lubricated, and holes are made in them to receive the oil for this purpose. The windlass is also fitted with mortice holes of the usual form, but these last are only used for the wooden pawls, or in the event of the socket ratchets becoming unserviceable. The same windlass is used with either sling wagon or sling cart.

The detachment consists of 9 Nos. and is told off as for M.L. gun drill, and formed up three paces in rear of and facing the wagon. The lighter natures of sling wagons are constructed to carry a gun by itself, or with its garrison standing carriage placed on the framework above.

TO ARRANGE STORES.

Arrange Stores.

The following stores are provided by the several Nos. if they are not already on the wagon:—

- No. 1. Two wood pawls and hammer.
- Nos. 2 and 3. Each a lever with rope attached and handspike each.
- Nos. 4 and 5. A handspike each.
- „ 6 and 7. Sling and thimbles.
- „ 8 and 9. One lashing rope ($2\frac{1}{2}$ -inch tarred rope, 6 fathoms), and 2 heavy drag-ropes.

Sling Wagon.

Section VII.

GENERAL DUTIES.

No. 1. Attends to the pawls, keys and unkeys the keep chain.

Left Side.

3. Has charge of the left lever and scotches the wheels in rear.

5. Has charge of a handspike, assists 3 at the lever, scotches the wheels in front, fixes the carriage rope.

7. Assists 3 at the lever, slings and unslings the gun, lashes handspikes and levers.

9. Assists in keying and unkeying the draught chain, and fixing the breech rope; assists to lash the breech.

Right Side.

2. Has charge of the right lever and scotches the wheels in rear.

4. Has charge of a handspike, assists 2 at the lever, scotches the wheels in front, fixes the carriage rope.

6. Assists 2 at the lever, slings and unslings the gun, lashes handspikes and levers.

8. Keys and unkeys the draught chain, fixes the breech rope, and lashes the breech.

The whole assist to limber up and unlimber.

TO TAKE POST ON THE WAGON.

Take post on the wagon.

Right turn.

Double march.

"*Take post on the wagon.*"—No. 1 gives "*Right turn,*" "*Double march,*" when the ranks open out, the front rank covering the left wheel, the rear rank the right; 2 and 3 halt one pace from the wheels.

TO SLING THE GUN.

Place the wagon.

Scotch the wheels.

Sling the gun.

Work levers.

High enough.

Out levers.

Fix the breech rope.

Prepare to raise the breech.

Heave.

Frap and make fast.

Lash up levers and handspikes.

"*Place the wagon.*"—The wagon is backed until the front of the axletree is a little in front of the trunnions. The muzzle of the gun being towards the rear.

"*Scotch the wheels.*"—2 and 3 scotch the wheels in rear, and 4 and 5 in front.

Section VII.

Sling Wagon.

"Sling the gun."—7 places the eye of the sling on the hook of the windlass, and passes the ends down in front of the axletree to 6, 6 places the thimbles on the trunnions, and passes the returns of the sling round them, handing up the ends in rear of the axletree to 7, who places them on the hooks.

"Work levers."—2, 4, 6, 3, 5, 7; assisted if necessary by 8 and 9, work the levers together till the gun is high enough, when *"High enough," "Out levers,"* is given.

"Fix the breech rope."—8, assisted by 9, makes an overhand knot on the top of the perch over the breech, with the centre of the breech rope, allowing the ends to hang down.

"Prepare to raise the breech."—2 and 3 put each a handspike in the bore, for the purpose of bearing down. 8 and 9 cross their ends of the breech rope from one to the other under the cascable, and then over the perch.

"Heave."—2 and 3 bear down, and 4, 5, 6, 7, 8, and 9 haul upon the breech rope on their respective sides, and when the breech is high enough, *"Frap and make fast"* is given. 8 and 9 cross the ends under the cascable a second time; change ends again, by passing them between the returns and breech; frap and make fast with a reef knot in front.

"Lash up levers and handspikes," 2 and 3 take up their levers; 4 and 5 the handspikes; 6 mounts on the frame, and 7 hands him the coins and short skids, the coins being placed on each side of the perch,* the short skids between the cheeks of the carriage. He then comes down. 2 and 3 place their levers, the points touching the breast transom. 4 and 5 lay the handspikes on the levers and steady them at the small ends, whilst 6 and 7 lash them in the following manner:—

They pass the lever ropes under and up in rear of the crossbar, close to the perch; change ends over the handspikes, haul taut; pass the ropes down in rear of, under, and up in front of the crossbar, change ends over the handspikes; then pass them down, change ends again under the perch, haul taut; then bring them up and make fast on the top of the handspikes.

TO PLACE A CARRIAGE AND SLING A GUN ON A SLING WAGON.

The gun is dismounted resting on skids, and its carriage on one side, with its breast nearly in line with the breech.

Prepare to unlimber.

Unlimber.

Lower.

Place the wagon.

Prepare to turn the gun carriage over.

Heave.

Off trucks.

* This applies when the carriage has been mounted.

Sling Wagon.

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"Prepare to unlimber."—No. 1 places the wooden pawls in the windlass. 2 and 3 place their levers in the sockets about horizontal, ready to bear down; 4, 5, 6, 7, 8, and 9 stand close in to the perch. 8 and 9 unkey the draught chain, No. 1 the keep chain, standing between the shafts when there are no horses.

"Unlimber."—2 and 3 bear well down, and 4, 5, 6, 7, 8, and 9 raise the perch off the pintail. No. 1 then draws the limber forward a little.

"Lower."—The perch is lowered gently to the ground; 2 and 3 withdraw their levers, and lay them on the ground outside the wheels.

"Place the wagon."—The wagon is run forward or backward, until the under part of the perch touches the base ring, in order to support the perch whilst the nose plate rests on the ground.

"Prepare to turn the gun carriage over."—The whole of the Nos. take post at the gun carriage in the same order as at the wagon; that is, the even Nos. on the right, and the odd on the left. The gun carriage is then brought parallel to the perch, at about the distance of its own breadth from it, with its front to the rear, and in line with the draught chain ring.

"Heave."—The Nos. on the side furthest from the perch lift from below; those on the other side haul over at the top of the cheeks. As soon as the carriage rests on the axletree arms, the Nos. hauling step over the perch, one by one, and at the next heave, the carriage is brought upside down upon the perch; the hauling Nos. taking care to prevent its falling too heavily upon it.

"Off trucks."—2, 4, and 3, 5, take off the fore trucks, and 6, 8, and 7, 9 the rear ones, the linch-pins being withdrawn by the highest No. at each truck. The trucks are placed flat upon the ground, and the linch-pin of each laid across it by the No. who withdrew it.

The carriage may now be lifted into its place on the top by the detachment, or hauled up by the windlass.

TO PLACE THE CARRIAGE.

Lift the rear of the carriage.

Place the lever.

Mount the carriage.

Lift. Shift the lever.

Lift.

Raise the rear of the carriage.

Out lever. Lower.

"Lift the rear of the carriage;" "Place the lever."—All the Nos. except 2 and 3 lift the rear of the carriage sufficiently high for 2 to pass his lever to 3, close to the trunnion holes. This lever is then double-manned by 4 and 5; 6 and 7 lift at the rear axletree arms; 8 and 9 in rear of the cheeks.

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Sling Wagon.

"Mount the carriage;" "Lift."—All the Nos. lift and heave until the lever touches the wheels.

"Shift the lever;" "Lift."—2 shifts the lever in rear of the bolts on top of the brackets. At *"Lift"* the carriage is lifted into its place, the trunnion holes fitting over the bolster.

"Raise the rear of the carriage;" "Out lever;" "Lower."—The rear of the carriage is raised; 2 withdraws the lever, and the carriage is lowered until the second step touches the crossbar.

TO PLACE THE CARRIAGE USING THE WINDLASS,

Turn carriage over.

Heave.

Off trucks.

Fix drag rope.

Levers take purchase.

Work levers.

High enough.

Out levers.

Off drag rope.

The drag rope is passed by 4 and 5 (after the carriage is turned over) under the breast transom, and made fast with a clove hitch to the centre of the rear axletree; the running end of the rope is passed by 2 and 3 twice round the windlass, and hauled taut. No. 1 removes the wooden pawl and holds on to the rope. *"Work levers;"* 2 and 3 work the levers, 4 and 5 use their handspikes to raise the carriage clear of the frame. When the carriage is in its place, *"High enough," "Out levers," "Off rope,"* is given.

The gun carriage being now in its place on the wagon, it is limbered up.

TO LIMBER UP.

Prepare to limber up.

Limber up.

"Prepare to limber up."—No. 1 puts a wooden pawl into a mortice hole; 2 and 3 place their levers in the iron sockets, which must be so fixed that the levers shall have a slight inclination upwards; 2 and 3 haul on the lever ropes; 4, 5, 6, 7, 8, and 9 lift the perch; No. 1 backs the limber.

"Limber up."—The eye of the perch is passed over the pintail; No. 1 keys the keep chain; 8 and 9 the draught chain.

TO PUT ON TRUCKS.

The trucks are placed on the axletree arms of the carriage, after the wagon has been limbered up.

Put on Trucks.

"Put on trucks."—2, 4, and 3, 5, raise the fore trucks on the frame, and roll them close to the windlass brackets; 2 and 3 then

Sling Wagon.

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quit them, and go to the rear of the wagon, whilst 4 and 5 steady the trucks. 6, 8, and 7, 9, put on the rear trucks and linchpins; 6 and 7 then turn round and relieve 4 and 5, who, together with 2 and 3, mount up, with one foot on the spokes of the wheel, the other foot on the frame, and put on the fore trucks. 6 and 7 hand up the linchpins, and assist to hold up the trucks. The linchpins of all the trucks are put in by the highest Nos. employed at them.

It is sometimes necessary to put on the truck on one side first, and then move the carriage to the right or left to place the others.

The carriage being now in position on the wagon, which has been limbered up, the gun is slung as already described.

TO DISMOUNT THE GUN AND CARRIAGE.

Place skids.
Unlash.
Scotch the wheels.
Unlash the breech.
Prepare to lower.
Bear down.
Unpawl.
Ease off.
Pawl.
Bear down.
Unpawl.
Ease off.
Unslung.
Remove trucks.
Prepare to unlimber.
Unlimber.
Dismount carriage.
On trucks.
Turn the carriage over.
Limber up.

"*Place skids,*" "*Unlash,*" "*Scotch the wheels.*"—6 mounts up, throws down the pieces of skidding and coins, comes down, and, assisted by 7, places them where directed; 6 and 7 then unlash levers and handspikes; 4 and 5 remove the handspikes, 2 and 3 scotch the wheels. 2 and 3 take their levers and go to their places, keeping the levers in their hands. 4 and 5 scotch the wheels in front with the coins.

"*Unlash the breech.*"—8 and 9 unlash the breech, lower it gradually, and clear away the returns.

"*Prepare to lower.*"—2 and 3 place the levers in the sockets, the small ends nearly touching the ground. No. 1 gives "*Bear down,*" and when the weight is off the windlass pawls, they are lifted by Nos. 1 and 7 at "*Unpawl.*"

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Sling Wagon.

"Ease off."—The levers are allowed to rise gradually, until nearly perpendicular.

"Pawl."—Nos. 1 and 7 drop the pawls; they then lift up the ratchet pawls, 2 and 3 assisting by pushing up the levers.

"Bear down," "Unpawl," "Ease off," until the weight is resting on the skids.

"Unsling."—6 and 7 cast off the sling.

"Remove trucks."—The trucks are taken off by the numbers who placed them.

"Prepare to unlimber," "Unlimber," "Dismount carriage,"

"On trucks."—The wagon having been unlimbered, 2 and 3 take a purchase with handspikes over the frame and under the second step; the other Nos. lift and haul down.

"Turn the carriage over," "Limber up," as before.

TO SLING MORTARS.

A 13-inch mortar, resting on skids, is slung like a gun, only the breech is to the rear; a piece of short skidding or fid is put into the muzzle, by which to raise and lash the muzzle to the perch. To raise the muzzle a clove hitch is made with the centre of the muzzle rope round the fid, and the ends are passed round the square ends of the windlass, which is worked, 8 and 9 holding on to the ends, which should come off on the outside.

TO SLING A 13-INCH MORTAR BED.

The wagon is backed over it in such a manner that the front of the bed may be towards the shafts. The bed is slung by 6 and 7 passing the sling round a roller or skid in the trunnion holes; when the bed is high enough it is lashed to the perch. The bed may also be slung by passing the sling and lashing rope under the running up bolts, as described for the mortar.

TO SLING A 10 OR 8-INCH MORTAR AND BED.

10 or 8-inch mortars are not dismounted for slinging. The coin is taken out, and the mortar lowered on the front transom of the bed. The 8-inch mortar and bed is slung as detailed for the 13-inch mortar, also the 10-inch mortar in the same way, but with the muzzle to the rear.

TO SLING A TRAVERSING PLATFORM.

A wooden dwarf traversing platform is slung with the front transom towards the front of the wagon, the rear blocks with trucks having been previously removed.

A wooden casemate platform is slung in the same manner. The rear trucks may be removed.

Sling Wagon.

Section VII.

In both cases the ends of the slings are passed round the sides of the platform, and lashed together underneath.

The windlass is worked until the upper part of the platform comes against the axletree. The end of the platform next to the limber is then raised with handspikes, and lashed to the perch.

The carriage may be left on the rear part of the platform in rear of the windlass, and be so carried.

Previous to slinging dwarf traversing platforms, the wagon should be unlimbered, and the rear block and trucks, which were removed, placed on the top across the frame of the wagon. *Vide* also page 597.

TO SLING GUNS OF 7 OR 12 TONS FROM TWO SLING WAGONS.

When two sling wagons are employed for the transport of 7 and 12-ton guns, a very good plan is to back the wagons over the gun from both ends, and sling the gun at the cascable and half-weight mark. The gun should be skidded as high as possible with the trunnions horizontal, before the wagons are run over it, so that the gun will not require to be lifted higher, but only the slack of the slings to be taken in. If, however, from the slings stretching, or from any other cause, it becomes necessary to raise the gun, the work of the windlass levers should be made lighter by applying a jack or long levers to assist in raising the gun; should this be neglected, the strain on the windlass levers will be so heavy, from the friction of the slings against the gun, that they will probably be broken. A small roller should be put through the breeching loop to guard against the breech sling slipping off the neck of the cascable. The axletree beds of the two wagon bodies are then lashed together from centre to centre.

It will be found that this method of suspending the gun places the mass much more under control when travelling than any other, as, when passing round sharp curves, the rear shafts are employed to aid the front in imparting change of direction.*

* See remarks in paragraph 3, p. 584, "moving heavy guns."

Section VIII.

Sling Cart.

Section VIII.—Sling Cart.

There are two descriptions of sling carts in the service, both of wood, the one, with wrought-iron fittings on the windlass, which will carry $3\frac{1}{2}$ tons; the other, with cast-iron fittings, will carry 56 cwt.

The detachment consists of 7 Nos., told off as for M.L. gun drill, and is formed up as for sling wagon.

TO ARRANGE STORES.

Arrange Stores.

The following stores are provided:—

- No. 1. Two wood pawls and a hammer.
- „ 2 and 3. A lever with rope attached, and handspike each.
- „ 4 and 5. A handspike each.
- „ 6. Sling, thimbles, and drag rope.
- „ 7. Prypole, with rope attached, and drag rope.

The detachment is formed up three paces in rear of and facing the cart.

No. 1 attends to the pawls and commands.

Left side.

3. Has charge of the left lever.

5. Has charge of a handspike, assists 3 at the lever, and raises the weight when it is to be lashed.

7. Assists 3 at the lever, slings and unslings the gun, lashes breech, handspikes and levers.

6 and 7. Place the prypole.

Right side.

2. Has charge of the right lever.

4. Has charge of a handspike, assists 2 at the lever, and raises the weight when it is to be lashed.

6 assists 2 at the lever, slings and unslings the gun, lashes breech, handspikes and levers.

TO PLACE THE CART.

Place the Cart.

“*Place the cart.*”—The cart is run over the gun, so that the axle-tree may be over the trunnions, and the breech of the gun to the rear.

Sling Cart.

Section VIII.

TO SLING THE GUN.

The same as with the sling wagon, with the following exceptions:—

"Lash up the breech."—4 and 5 take a handspike each and cross them under the breech, facing the gun. 6 brings up the prypole, and 7 passes the point of it over the axletree, and so far under the iron transom that the direction of the prypole rope, when the breech is lashed, may be vertical. 6 then passes the prypole rope under the neck of the cascable to 7, who passes it over the prypole, in rear of the wall knot, to 6. 6 again passes it under the cascable to 7, who hauls taut, 6 assisting him. 2 and 3 double man the handspikes.

"Heave."—All the Nos. heave and haul until the axis of the piece is horizontal.

"Frap and make fast."—The returns of the rope are frapped together from below upwards, 7 passing the running end of the rope between the returns and the breech, close to the cascable, and 6 passing it round the outside of the returns; 2, 3, 4, and 5 heaving up the breech, in order that the frappings may be taut. Thus they proceed alternately, hauling taut each time, until enough rope only is left for 7 to make two half hitches round the returns next him.

"Lash levers and handspikes."—2 and 3 place their levers on their respective sides of the prypole, step outwards and turn inwards. 4 and 5 place their handspikes on the top of the levers, and stand to steady them, keeping the small ends of the levers and handspikes flush with that of the prypole. 6 and 7 lash the whole firmly together with the lever ropes, which are crossed under and over, one half the turns in rear of the prypole rope, the other half in front, and make fast on the top with a reef knot.

If there be two short skids, they are laid lengthwise on the top of the bars of the cart by 6 and 7, who secure them with a piece of lashing rope.

TO UNSLING A GUN.

6 and 7 unlash and lower the breech, and the gun is lowered as with the sling wagon.

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Platform Wagon.

Section IX.—Platform Wagon.

The platform wagon consists of a fore and hind carriage, with a platform fitted over them.

The platform consists of a strong oak frame with side boards attached, which is bolted to the bolster of the hind carriage and pivots on the bolster of the fore carriage. The splinter bar is fitted with two pairs of frame shafts and outriggers for swingletrees, so that four horses can be harnessed abreast; it is also fitted for a pole for bullock draught.

Upon the sides of the wagon are cleats for carrying either a mortar, mortar bed (10-inch mortar and bed, 13-inch mortar, or bed, or two 8-inch mortars and beds), or 64-pr. R.M.L. converted gun.

When used to carry the W.I. 64-pr. R.M.L. gun, the wagon is specially fitted, namely, the cleats just mentioned are removed and replaced by special ones to take the trunnions of the gun.

It is constructed for a maximum load of 64 cwt.

The muzzle should always be to the front when the gun is in position for travelling on the wagon.

The detachment required consists of 19 Nos., told off as for M.L. gun drill.

TO ARRANGE STORES.

Arrange Stores.

"Arrange stores."—The same stores are provided by the several Nos. as for parbuckling a gun up the side of a standing garrison carriage. Vide page 526.

GENERAL DUTIES.

The general duties are the same as for parbuckling.

TO TAKE POST.

As with a sling wagon.

There are three different methods by which a gun may be mounted on, or dismounted from, a platform wagon, namely:—

1. By gyn.
2. By parbuckling up or down the front of the wagon.
3. Do. Do. side of the wagon.
4. Dismounting from wagon over the rear on rollers.

1. The first case hardly calls for any remark, the gun is raised with the gyn till high enough, when, the platform wagon having been run under it, the gun is lowered at once into the travelling position on the wagon.

Platform Wagon.

Section IX.

For slinging the gun a 6-inch white rope gun sling, 12 feet in length, applied under cascable and fid in the bore, would probably be found most convenient.

It may be remarked that should it be required to shift a gun from its carriage on to a platform wagon, or *vice versa*, the gun would probably prove to be the most easy and expeditious method; if, on the other hand, it be required to place a gun, resting on skidding on the ground, on the wagon, parbuckling up the front would be preferable.

2. Parbuckling up the front of the wagon is a very simple and rapid method of placing a gun, already dismounted and skidded, on the wagon; it is performed as follows:—

The gun should rest on skidding 9 inches high; the wagon is placed with the splinter bar towards the gun, parallel to its axis, and distant about 12 feet. The frame shafts are removed, wheels scotched, frame supported in front by two upright oak skids, 3 feet long, and by coins, scotches, or skidding, inserted between it and the fore carriage; the parbuckle skids, 14 feet by 8 inches by 8 inches, are then placed with their upper ends resting on the front part of the frame, bevel up, their lower ends bevel down on the ground in such a position that the gun can travel off the short skids on which it rests on to them; the standing ends of the parbuckle ropes are made fast round the rear axletrees of the wagon, the running ends being led under and round the gun are passed to the rear inside the wheels and manned. The gun is parbuckled up on to short oak skids placed on the frame to receive it; long skids and parbuckle ropes being removed, it is slewed a quarter circle to bring the breech towards the rear of the wagon, moved to the rear, either by rowing or on rollers, and lowered into the travelling position, in doing which the use of a 12-foot lever will be found convenient for lowering the breech. Dismounting, being the converse, need not be described.

3. Parbuckling up the side of the wagon:—

The gun should rest on skidding 9 inches high; the wagon is placed alongside, and about 12 feet distant, front of the wagon towards the muzzle, trunnion cleats about opposite the trunnions; the fore carriage is locked hard over away from the gun, the hind wheel on the side next the gun is removed, and the axletree firmly supported in a horizontal position by means of skidding or a garrison standing carriage. If the latter it may be done as follows:—Back the carriage in under the rear of the platform wagon until in a convenient position for raising the rear axletree with handspikes, 1st order, applied over a 4-inch piece placed across the steps of the carriage. Having thus raised the rear of the wagon, remove the hind wheel next the gun far enough to admit of the garrison standing carriage being run up to the wagon axletree bed; do this and support the axletree with skidding, placed on the step of the carriage, on the side next the gun, then remove the wheel altogether and support the side of the wagon nearest

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Platform Wagon.

the gun with upright 3-foot oak skids, the supports being placed near the spots where the long skids will rest in parbuckling, small coins or medium scotches being inserted between the frame and fore carriage to support the former.

Place long skids, 14' x 8" x 8," their upper ends, bevel up, resting on the wagon, their lower ends bevel down, so arranged that the gun may travel off the short skids on which it rests on to them. Fix parbuckle ropes. The standing ends are secured to the axletrees of the wagon on the side furthest from the gun, the running ends passed under and over the gun, across the wagon, and manned. The gun having been parbuckled up on to short skids placed across the wagon to receive it, the long skids and parbuckle ropes are removed, the gun is lowered into the travelling position on the wagon, and the hind wheel put on.

This method will not be found so simple or expeditious as the one previously described.

TO DISMOUNT A GUN OVER THE HIND PART OF A PLATFORM WAGON BY MEANS OF ROLLERS.

This is a most expeditious mode, but it must not be resorted to when the *terreplein* of a work is paved or uneven; the ground on which the wagon wheels rest ought to be firm; the operation requires to be done with expertness, or else the swell of the muzzle, when the gun is falling, is apt to catch the hind transom of the wagon, and damage it.

The same stores are required, and in addition two 24-inch rollers, with about 3 feet of spun yarn.

Place rollers.

Fix steadying handspikes.

Fix breech and muzzle ropes.

Heave.

Halt.

Cast off steadying handspikes.

Hook dragropes.

Heave.

"Place rollers," "Fix steadying handspikes," "Fix breech and muzzle ropes."—The gun is raised and rollers placed under it, and at "Heave" the gun is pulled gently to the rear, the greatest attention being paid that the breech does not preponderate.

When the gun has been brought so far to the rear as to bring the vent over the hind part of the wagon, "Halt" is given.

The rollers are now carefully arranged; one of them being placed half way between the centre of gravity of the gun and the rear of the wagon, and the other half way between the rear of the wagon and the muzzle.

"Cast off steadying handspikes," "Hook drag ropes."—10 casts off the muzzle rope, then places himself in the shafts; 2 and 8 hook drag ropes into the drag washers on the rear axletree arms,

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which are manned by 4, 5, 6, 7, 8, and 9; 19 makes fast a piece of spunyarn to the rear roller, and will stand on one side, in order to draw it from under the gun the moment it leaves the wagon; at the word "*Heave*," the wagon is drawn forward, whilst the breech dragrope Nos. pull the gun smartly to the rear.

The muzzle roller is caught by the swell of the muzzle, and quits the wagon at the same time as the gun, thus preventing damage to the hind part of the wagon.

TRANSPORT OF MORTARS AND THEIR BEDS.

The platform wagon is calculated to carry one 13-inch mortar, or one 13-inch mortar bed. One 10-inch mortar on its bed, or two 8-inch mortars on their beds.

There are two methods of placing mortars, or their beds, or mortars on their beds, on the wagon:—

1. By gyn.
2. By means of long skids.

To place a 13-inch mortar on the wagon by means of a gyn, the mortar should first be dismounted, the gyn is then placed over it, the mortar slung as described at page 493, raised with the gyn till high enough, when, the wagon having been run underneath, it is lowered into the travelling position.

The mortar may be slung without dismounting, and raised with the gyn, as described at page 493.

The 13-inch mortar bed is treated in the same way, being slung by one of the methods described at page 493.

The 10-inch mortar having been brought vertical, the coin is removed and the muzzle lowered to rest on the front transom. The bed, with mortar on it, is then slung by one of the methods described at page 489, raised with gyn, and lowered into position on the wagon, or the mortar and bed may be placed on the wagon separately, which for travelling far would be preferable.

The 8-inch mortar with its bed is treated in the same manner as the 10-inch on its bed. With mortars, several returns of heavy dragrope may be employed for raising, instead of a gun sling; vide 2nd method of slinging 13-inch mortars, page 493.

When mortars or mortar beds are placed on a platform wagon by means of long skids, it may be done in the following manner:—

TO MOUNT A 13-INCH MORTAR ON A PLATFORM WAGON UP THE REAR ON CRADLED AND WATERED SKIDS.

The mortar is dismounted and skidded, with axis horizontal, about 6 inches off the ground. The wagon is placed with its rear towards the breech of the mortar, and about 12 feet distant, the middle of the frame being in line with the axis of the piece, and the wheels are scotched. The long skids are then placed nearly touching each other, their upper ends, bevel up, on the rear

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Platform Wagon.

part of the wagon, to which they should be lashed (and the rear part of the wagon frame supported by upright 3-foot skids), their lower ends bevel down, so that the mortar can be hauled off the skids on which it rests on to them; the skids are cradled and watered. The double blocks of two luff tackles are secured by lashing or straps to the trunnions, the single blocks being made fast to the end of the skids or to any convenient part of the wagon, so as to get as fair a lead as possible. The falls being manned the mortar is hauled up the long skids, until its breech is received on a roller placed across the wagon frame,* the luff tackles are cast off, and the mortar moved on rollers till far enough to the front, in doing which handspikes, placed at an inclination under the trunnions, may be employed to keep them horizontal; the mortar is then lowered into position on the wagon.

TO PLACE A 13-INCH MORTAR BED ON A PLATFORM WAGON
BY MEANS OF LONG SKIDS AND ROLLERS UP THE REAR.

The wagon is placed in prolongation of the bed with its rear towards it and about 12 feet distant, and the wheels are scotched. The bed is raised, and a ground roller placed underneath, and across it a little on the wagon side of its centre of gravity. The long skids are placed with their upper ends, bevel up, on the rear part of the wagon frame, which should be supported as before described; their lower ends, bevel down, resting on the ground under the ends of the brackets of the mortar bed; drag ropes or luff tackles are made fast to the running up bolts on both sides of the bed at the end next the wagon, and manned.

The bed is now hauled up the long skids on rollers placed as required; as its centre of gravity passes beyond the bevels at the upper end of the skids it will dip on to a roller placed across the frame to receive it, a check drag rope should at this point be made use of in rear to prevent the bed going with a rush on to the wagon; it is then moved on rollers on the wagon till far enough to the front, and lowered into position.

10-inch and 8-inch mortars on their beds, coins having been removed, are treated in the same manner.

If the 10-inch mortar and its bed are placed on the wagon separately by means of long skids, it is done as described for a 13-inch.

Dismounting is the converse of the foregoing; but it is generally more convenient to dismount the 13-inch mortar down the front, as when travelling trunnions foremost it does not injure the skids. The front of the wagon should be supported as before described.

* One tackle instead of two may be used, being secured to the mortar as follows. The centre of the selvage is placed on the top of the mortar and in front of the trunnions, the two ends being led under the trunnions, the double block of the tackle is hooked into the two bights. The men stand on the wagon to heave.

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The 13-inch mortar bed, and 10-inch and 8-inch mortars on their beds, may be hauled up the rear on long watered skids placed under the brackets of the bed, by means of luff tackles, the skids being strongly lashed to the rear part of the wagon frame, but it is heavier work, and with fir skids their upper surface gets ploughed up and injured, which renders the operation an undesirable one unless rendered necessary by the want of rollers.

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Section X.Trench Cart.—Hand Cart.

Section X.—Trench Cart.—Hand Cart.

The trench cart is a strong cart capable of carrying a load of one ton.

It has fixed shafts, moveable sides, head and tail board. The frame is of oak, the boarding of elm. It is painted red to distinguish it from the hand cart.

Its weight is 7 cwt.

The mode of transporting 10-inch mortars or their beds, and 8-inch mortars on their beds on trench carts is described under "moving and mounting ordnance" at page 611.

It is chiefly used for moving stores, &c.

• **HAND CART.**

The hand cart is similar to the trench cart, but of lighter construction; it will take a load of 15 cwt. It is painted lead colour.

Its weight is $4\frac{3}{4}$ cwt.

It is frequently fitted with a pole with cross-handle, for man draught, instead of shafts.

It is chiefly used for moving stores.

Mounting and Dismounting Guns.

Section I.

PART VIII.

MOVING, MOUNTING, AND DISMOUNTING ORDNANCE CARRIAGES AND PLATFORMS (64-pr. to 12.5-inch R.M.L. Guns).

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SECTION I.—Mounting and Dismounting Guns.

INTRODUCTORY REMARKS.

In this subject, each nature of ordnance is considered separately, whether mounted on standing carriages, traversing platforms, in open batteries, or casemated works.

The operations with the smaller natures have been somewhat fully described as forming the groundwork of instruction, the principles being the same throughout. If they are once thoroughly grasped, no difficulty will be experienced in dealing with the heavier natures.

Estimates of "stores" are only *approximate*, and may require to be modified according to local circumstances.

In the following operations, the strength of the detachment and description of material to be used varies with the size and nature of the gun to be moved; but the detachment is "told off," the several Nos. (as far as possible) perform the same duties, and the stores are arranged as detailed in Part VI.

Previous to mounting or dismounting a gun, the sights, cap-squares, also all fittings liable to injury, are to be removed, and the carriage and platform scotched up.

N.B.—In securing drag-ropes to the cascable or trunnion of a gun for hauling, rolling, or slewing, the hook end should *not* be used to make fast with, as should the rope become detached when the strain is on it the hook comes back with great force and is likely to cause an accident; this is especially the case in dismounting by rolling over the side.

Section I.

Mounting and Dismounting Guns (64-Pr.).

MOUNTING AND DISMOUNTING 64-PR. R.M.L. GUNS IN OPEN BATTERIES.

When mounted on garrison standing carriages in open batteries, these guns may be mounted and dismounted by any of the following methods:—

1. By gyn.
2. By long skids, watered, up or down the rear.
3. By „ with rollers „
4. By „ parbuckling, up or down the side.
5. Dismounted by rolling over the side, provided a soft place can be selected for the gun to fall on.

By Gyn.

For this purpose a 16-foot light gyn is most convenient.

The method of placing and working the gyn being described under “Machines,” further remark is unnecessary.

A sling of 6-inch white rope 12 feet long is suitable for slinging the gun.

For operations 2, 3, 4, and 5, it is necessary first to raise the gun out of the trunnion holes, which is effected as follows:—

TO RAISE 64-PR. R.M.L. GUN ON GARRISON STANDING CARRIAGE OUT OF THE TRUNNION HOLES AND THE CONVERSE.

Strength of Detachment, 19 Nos.

Stores required.

Handspikes, common, 6-ft. . . . .	..	..	8
Scotches (large, medium, and small) ..	..	..	12
Skids, oak (3' x 4" x 4') ..	..	..	3

Remove sights and fittings.

Scotch up trucks.

Raise the gun out of the trunnion holes.

Prepare to bear down the muzzle.

Bear down.

Come up, scotch up.

Prepare to lift.

Lift.

Lower, scotch up.

The sights and fittings are removed under No. 1's superintendence, and the trucks scotched up, front and rear, with large scotches.

“*Raise the gun out of the trunnion holes,*” “*Prepare to bear down the muzzle.*”—No. 2 places a handspike in the bore, point first, 3 one under it as a wedge, double manned by 8 and 9; 4 a handspike

Mounting and Dismounting Guns (64-Pr.).

Section I.

over that of 2, close to the muzzle to 5, double manned by 10 and 11; 12 a handspike over the neck of the piece to 13, double manned by 14 and 15; 16 a handspike over the chase to 17, double manned by 18 and 19.

The whole looking towards the gun, Fig. 1.

Fig. 1.

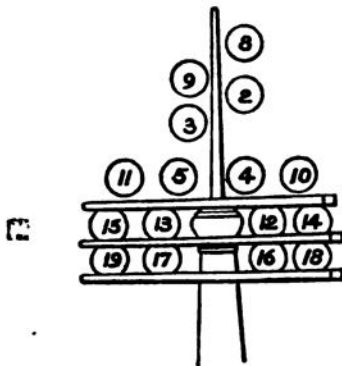
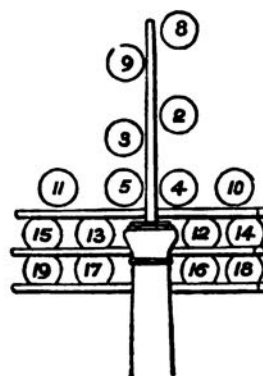


Fig. 2.



"Bear down."—The whole bear down; 6 and 7 remove the elevating screw; 7 places a 4-inch piece across the carriage on the top step.

"Come up," "Scotch up."—The gun is allowed to rest on the 4-inch piece, 6 and 7 scotch up.

"Prepare to Lift."—3 shifts his handspike to lie over that of 2; 4 his underneath those in the bore; 12 and 16 theirs underneath the gun, Fig. 2.

"Lift."—The whole lift till 6 can pass a 4-inch piece right through both trunnion holes. Sometimes it is convenient to effect this in two lifts, in which case the trunnions are allowed to rest after the first lift on the end of a 4-inch piece in each trunnion hole.

"Lower," "Scotch up."—The gun is allowed to descend on the 4-inch piece and scotched up.

The height to which a gun is raised out of the trunnion holes depends on the operation which is to follow. Lowering into the trunnion holes is the converse of the foregoing.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN BY
WATERED SKIDS UP OR DOWN THE REAR.

Strength of Detachment 19 Nos.

Stores required.

Dragropes, heavy	..	..	..	..	2
Handspikes, common, 6-ft.	..	..	..	..	8
Lashings, white or tarred, 1½-inch, 3 fathoms each	4
Luff tackles, complete	2
(A. M.)					2 L

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Mounting and Dismounting Guns (64-Pr.).

Planks, oak, half, 4' x 12" x 3"	2
Do. fir, whole, 10' x 17" x 3"	2
Roller, ground, 6" x 3' ..	..	..	1
Scotches, of sorts ..	..	..	12
Skids, fir, 14' x 8" x 8"	..	..	2
Do. oak, 3' x 4" x 4"	..	..	3
Selvagees ..	..	..	2
Water bucket, filled, and brush..	..	..	1

To Dismount the Gun.

The gun is first raised out of the trunnion holes as already described, till the trunnions rest on a 4-inch piece in each trunnion hole.

"Place skids, make fast breech drag-rope."—8, 9, 10, and 11 place the skids with the lower ends, bevel down, resting on a 4-ft. oak plank, the upper ends bevels up, on the front transom of the carriage. They should be launched up as far as possible, and securely lashed and cradled by 6, 7, 8, and 9 in the following manner:—The lashing ropes secured to the rope grummets on the outside at the upper ends of the skids, are passed out to the front between the cheeks of the carriage, then back on the outside and through the eyebolts, and so on, and are finally frapped to get in the slack. The skids are lashed through the grummets at their lower extremities to prevent their opening out, and are cradled by jamming a large scotch in under the lower end of each skid from the outside. The skids are then well watered. 6 and 7 attend to the ground roller, which is placed to receive the breech of the gun as it quits the long skids; 11 makes fast a drag-rope to the cascade.

"On the breech rope," "Taut," "Heave."—On the caution to man the breech-rope, 2 and 3 apply their handspikes over the front of the cheeks of the carriage and under the gun to give it a start; 4 and 5 double manning; the remaining numbers, with the exception of 6 and 7, man the breech-rope, by means of which the gun is hauled down the skids on to the ground roller, and so dismantled.

The upper surface of the roller should be a little below the prolongation of the upper surface of the long skids.

"Cast off breech-rope," "Remove long skids," "Arrange Stores."

To Mount the Gun.

In mounting a 64-pr. R.M.L. gun by means of long watered skids up the rear, the following points have to be attended to:—

1st. If the ground is at all soft, it is advisable to use planks under the ground roller, or the carriage will be pulled towards the gun instead of the gun towards the carriage; the latter may be further kept from moving by jamming a large coin under the rear axletree.

Mounting and Dismounting Guns (64-Pr.).

Section I.

2nd. The ground roller is placed under the gun, close in front of the centre of gravity; the breech is allowed to rest on the ground, so that there may be room under the muzzle for arranging the long skids. These are placed as before, only as low down as possible (provided their upper extremities have sufficient bearing on the front transom), and are lashed as follows:—

The lashing ropes secured to the rope grummet on the outside, at the upper ends of the skids, are passed out to the rear between the cheeks of the carriage, then round in rear of the most convenient step on either side, through the eyebolts, and so on. The lower ends of the skids, which are supported on oak planks (two deep, if planks are used under the ground roller) are lashed and cradled as before, and when the skids are in position, the ground roller should be half way between their lower extremities and the base ring.

3rd. Two luff-tackles are used to move the gun, the single blocks being hooked by 10 and 11 into the two ends of a selvagee placed across the upper part of the breast of the carriage, and the double blocks by 12 and 13 into the two bights of a selvagee put over the cascable, as in Fig. 3.

Fig. 8.



A handspike applied through the breeching loop may be employed to keep the trunnions horizontal until the gun takes the long skids.

Place skids. Hook tackles.

Taut. Heave.

Prepare to bear down. Bear down.

Remove skids. Cast off tackles.

Arrange stores.

With the exception of those points already referred to, the operation is the converse of dismounting.

The Nos. man the tackles on their own sides, and the gun is hauled up the skids until the trunnions rest on the points of handspikes placed in the trunnion holes by 6 and 7. The muzzle is then borne down, and the skids and tackles cleared away by the Nos. who placed them, 6 and 7 working out their handspikes.

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Section I.

Mounting and Dismounting Guns (64-Pr.).

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN BY LONG
SKIDS, WITH ROLLERS.

Strength of Detachment, 19 Nos.

Stores required.

Drag ropes, heavy	..	..	..	2
Handspikes, common, 6-ft.	..	..	..	8
Do. do. 7-ft.	..	..	..	2
Lashings, 1½", 3 fathoms each.	..	..	..	2
Mauls	..	..	..	2
Luff tackles, complete	..	..	..	2
Rollers, sabicu, shifting 14" x 5"	..	..	..	1
" " " 24" x 5"	..	..	..	2
" Elm, ground 6" x 3'	..	..	..	1
Scotches of sorts	..	..	..	12
Skids, fir, 14' x 8" x 8"	..	..	..	2
" oak, 3' x 4" x 4"	..	..	..	3
Selvagees	..	..	..	2

To Mount the Gun.

The gun should be resting on a ground roller, just in front of its centre of gravity, and the carriage placed in front of it.

*Place skids. Hook tackles.**Taut. Heave.**Prepare to bear down. Bear down.**Remove skids. Unhook tackles.*

"Place skids," "Hook tackles."—8, 9, 10, and 11 place the long skids, the upper ends, bevel up, resting on the breast transom, the lower ends on the ground under the muzzle of the gun, arranged so that their upper surfaces are high enough to allow the trunnions to clear the top step of the carriage. No. 8 passes a handspike through the breeching loop to 9; if there be none, steadying handspikes must be fixed in the usual way. No. 11 places a selvagee over the neck of the cascable, and passes the ends down between the handspike and the breech, crossing the ends underneath, and bringing them over and around the handspike; 12 and 13 hook the double blocks to them; 10 and 11 hook the single blocks to a selvagee laid across the front of the carriage by 10. Nos. 6 and 7 scotch the trucks. The whole of the Nos. then man the tackles on their own sides, except 6 and 7, who attend to the rollers, and 8 and 9 who stand to the steadying handspikes.

"Taut."—The Nos. on the tackles haul in the slack. 6 and 7 place a 24-inch roller on the skids ready to receive the muzzle when it dips; this roller should be under the centre of gravity when the ground roller leaves the breech; in order that this may be so, it is frequently necessary to lift the muzzle and shift the roller back.

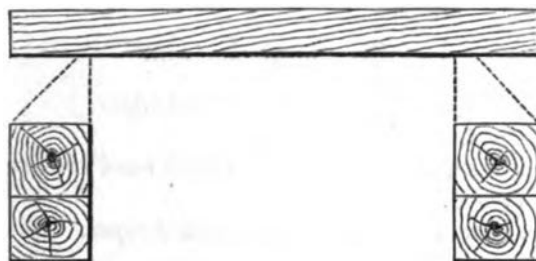
Mounting and Dismounting Guns (64-Pr.).

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"Heave."—The Nos. heave on the tackles, both sides working together; the rollers being at the same time kept perfectly square, otherwise the gun will be liable to slew, and so tip over. The 14-inch roller should be placed so that when the trunnions arrive over the trunnion holes, the roller will be a little in rear of the centre of gravity. When the gun is nearly high enough a 4-inch piece of skidding is laid across the trunnion holes, and Nos. 2 and 3 each place a handspike in the bore, double manned by 4 and 5, in order to lift or bear down the muzzle as may be required.

"Remove skids," "Unhook tackles."—The muzzle is borne down, and the skids and tackles removed by the Nos. who placed them, the breech being allowed to descend on a 4-inch piece placed by Nos. 6 and 7 on the top steps, with a small scotch under each end, to enable it to clear the long skids. Vide fig. 4.

Fig. 4.



The gun is then lowered into the trunnion holes, but before doing this the breech 4-inch piece should be allowed to rest on the top steps of the carriage.

To Dismount the Gun.

This operation is the converse of the foregoing, and the same stores are required.

Place skids. Hook tackles.

Bear down the muzzle.

Raise the muzzle.

Ease off.

The gun is raised out of the trunnion holes, the skids placed and tackles hooked as before, a turn being taken with the running ends round the front axletree arms, Nos. 18 and 19 holding on. The muzzle is borne down, and the 14-inch roller placed under the gun as near the centre of gravity as possible; then raised and the tackle eased off by Nos. 18 and 19, until the breech dips on to the 24-inch roller placed on the skids to receive it. The Nos. then man the tackles and ease off until the gun is nearly at the bottom of the skids, when Nos. 6 and 7 place a ground roller to receive it, and 11 makes fast a dragrope to the breech. As soon as the gun takes the ground roller, the Nos. above No. 10 quit the tackles and man the dragrope, and the gun is hauled to the rear, until it rests with its centre of gravity on the ground roller.

Section I.

Mounting and Dismounting Guns (64-Pr.).

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON A GARRISON
STANDING CARRIAGE, BY PARBUCKLING OVER THE SIDE.

Strength of Detachment, 19 Nos.

Stores required.

Drag ropes, heavy	..	..	..	..	2
Handspikes, common, 6-foot	..	..	..	..	8
Parbuckle ropes, $4\frac{1}{2}$ -inch, tarred, 12 or 18 fathoms	..	..	..	..	2
Scotches, of sorts	..	..	..	..	12
Skids, fir 14' x 8" x 8" ..	..	..	..	..	2
„ oak 3' x 9" x 6" ..	..	..	..	..	2
„ „ 3' x 6" x 6" ..	..	..	..	..	2
„ „ 3' x 4" x 4" ..	..	..	..	..	3

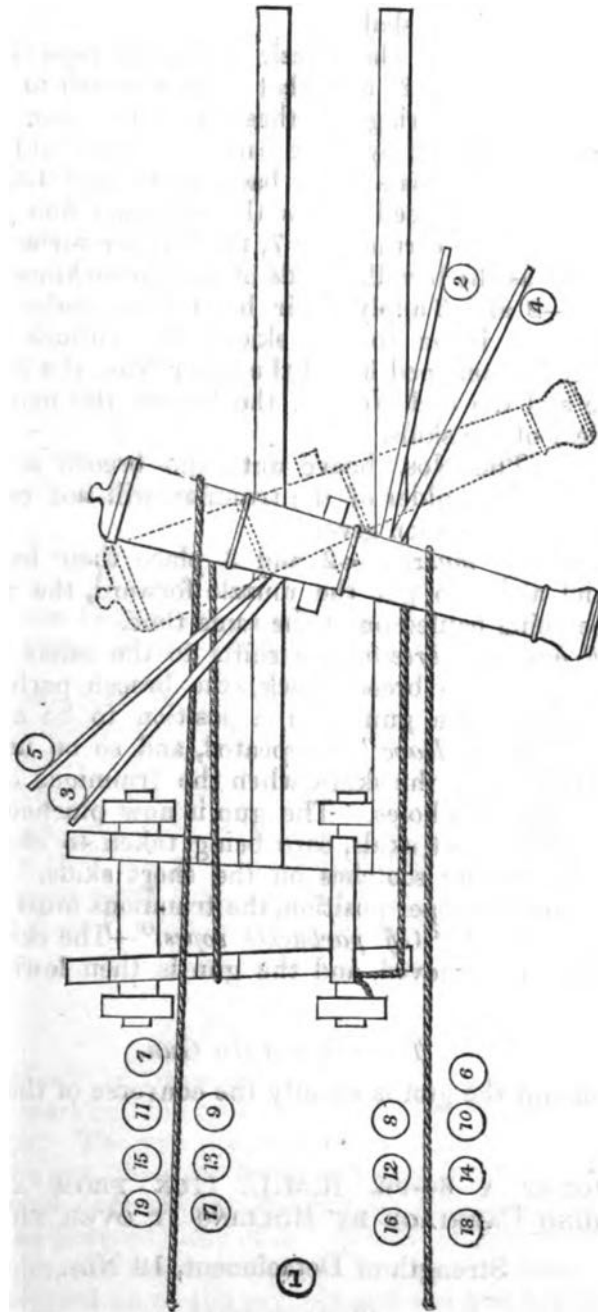
*To Mount the Gun.**Place skids. Fix parbuckle ropes.**Taut. Heave. Halt.**Forward the muzzle. Pinch back the breech.**Heave.**Remove skids. Off parbuckle ropes.*

The carriage is placed parallel to the gun, which is resting on short skids 9 inches off the ground, at the length of the long skids from it, the trunnion holes being opposite to the trunnions. (Fig. 5.)

Mounting and Dismounting Guns (64-Pr.).

Section I.

Fig. 5.



"Place skids," "Fix parbuckle ropes."—One end of the muzzle skid is placed just in front of the trunnion hole, and one end of the breech skid just in front of the ovolo, bevels up, skids parallel to each other, and perpendicular to the carriage; the ends which rest on the carriage are not to project above two inches on

ction I.

Mounting and Dismounting Guns (64-Pr.).

the inside of the cheeks; 8 and 10 place the muzzle skid, and 9 and 11 the breech one, which should be supported in the middle if much worn or shaky.

The standing end of the muzzle parbuckle rope is fastened to the fore axletree by 12, and that of the breech to the eyebolt, on the side of the carriage furthest from the gun by 13, the running ends are passed over the carriage under and around the gun by 6 and 7, who pass them back to 12 and 13. Pieces of short skidding are placed across the trunnion holes by 6, and the upper step of the carriage by 7, their upper surfaces being on the same level as the bevelled ends of the parbuckling skids.

"Taut."—2 and 3 apply their handspikes under the gun to assist in rolling it on to the skids; the parbuckle ropes are stretched out and manned by all the other Nos., the even Nos. on the muzzle and the odd Nos. on the breech, the handspike men standing clear of the skids.

"Heave."—The Nos. heave until the breech is just so far forward that the shoulder of the trunnion will not catch against the skid. *"Halt"* is then given.

"Forward the muzzle."—2 and 3 place their handspikes in the bore and assist to get the muzzle forward, the muzzle parbuckle rope being hauled on at the same time.

"Pinch back the breech."—3 shifts to the other side of the gun and pinches the breech back, the breech parbuckle being eased off. When the gun is in a position to be again moved forward the word *"Heave"* is repeated, and so on until the gun arrives at the top of the skids, when the trunnions ought to be opposite the trunnion holes. The gun is now pinched or allowed to roll on to the short skids, care being taken to check it, when necessary, by placing scotches on the short skids. Should the vent not be in the proper position, the trunnions must be slewed.

"Remove skids," "Off parbuckle ropes."—The skids and parbuckle ropes are removed, and the gun is then lowered into its place.

To Dismount the Gun.

To dismount the gun is exactly the converse of the foregoing.

TO DISMOUNT A 64-PR. R.M.L. GUN FROM A GARRISON
STANDING CARRIAGE BY ROLLING IT OVER THE SIDE.

Strength of Detachment, 19 Nos.

Stores required.

Dragropes, heavy	..	..	2
Handspikes, common, 6-feet	..	..	8
Scotches, of sorts	..	..	12
Skids, oak, 3' x 9" x 6"	..	..	2
„ „ 3' x 4" x 4"	..	..	3

Mounting and Dismounting Guns (64-Pr.).**Section I.**

*Raise the gun out of the trunnion holes.
 Lift and slew. Lower. Scotch up.
 Bear down and slew. Come up. Scotch up.
 Fix drag rope.
 Unscotch. Heave.*

The gun is raised out of the trunnion holes sufficiently high to allow the gun to be slewed sideways until it is nearly over the cheek, Nos. 6 and 7 scotching up. Two 6" x 9" skids are placed against the side of the carriage to protect the trucks. No. 11 takes a turn round the gun with a dragrope, making fast the standing end to one of the trunnions. All the Nos. except 6 and 7 man the dragrope.

"Unscotch."—6 and 7 withdraw their scotches.

"Heave."—The Nos. on the dragrope heave smartly, and the gun falls on the ground clear of the carriage. This operation should be performed with the gun carriage placed so that the gun will fall on soft ground and not on the platform.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON OR FROM A TRAVERSING PLATFORM IN AN OPEN BATTERY.

These guns may be mounted or dismounted by any of the following methods:—

1. By gyn.
2. By 20' x 9" x 9" skids, watered, up or down the rear.

An 18-foot light gyn, giving more lift than the 16-foot gyn, will probably be found most suitable for the purpose.

Sling, 6-inch white rope, 12 feet long.

With an A or B pivot platform the mode of procedure will be as follows:—

To Dismount the Gun.

The platform is traversed into a convenient position for placing and working the gyn. The carriage is then run back to the rear stops. The gyn placed with its head over the centre of gravity of the gun, the splay being sufficient to allow of the platform being traversed over towards the prypole sufficiently far to enable the gun to be lowered clear of it. When the gun is clear of the trunnion holes, the carriage is run up to the front stops—the platform traversed up to the prypole and the gun lowered.

C. Pivot.

In this instance it will be necessary before placing the gyn to run the gun either up or back as far as possible, and make two lifts of it. (See also page 472).

Section I.

Mounting and Dismounting Guns (64-Pr.).

* The gun is, in the first instance, lowered on to short skids on the platform, then the gyn is re-adjusted so that when the weight is taken the gun is allowed to swing in a little straight towards the cheeks, and the platform being traversed in the opposite direction, room is afforded for lowering the gun on to the ground.

D. Pivot.

In this case the gun must be run back just so far that the muzzle of the gun will clear the work when the gun is lowered.

The gyn should be so placed over the gun that when the platform is traversed over, the cheeks will be parallel to it.

In these operations, the gyn may often be afterwards employed with advantage for dismounting the gun carriage or for turning over the platform.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON TRAVERSING PLATFORM BY LONG SKIDS, WATERED, UP OR DOWN THE REAR.

Strength of Detachment, 19 Nos.

Stores required.

Dragropes, heavy	..	..	..	2
Handspikes, common, 6-ft.	..	..	..	8
Lashings, white or tarred, 1½-inch, 3 fms. each	..	..	..	4
Luff tackles, complete	..	..	..	2
Planks, oak, half, 4' x 12" x 3"	..	..	..	2
Do. fir, whole, 10' x 17" x 3"	..	..	..	3
Roller, ground, elm, 6" x 3'	..	..	..	1
Scotches, of sorts	..	..	..	20
Skids, fir, 20' x 9" x 9"	..	..	..	2
Do. oak, 3' x 9" x 6"	..	..	..	4
Do. do. 3' x 6" x 6"	..	..	..	4
Do. do. 3' x 6" x 3'	..	..	..	4
Do. do. 3' x 4" x 4"	..	..	..	4
Selvagees ..	..	..	..	2
Water bucket, filled, and brush..	..	..	..	1

To Dismount the Gun.

The operation is nearly identical with that of dismounting the gun, by like means, on a garrison standing carriage.

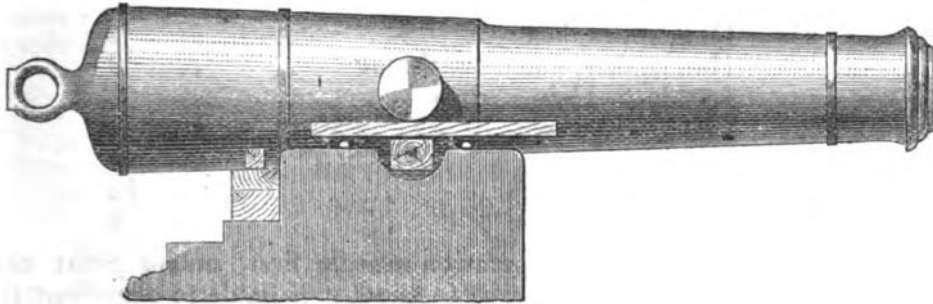
The gun should first be run up far enough to allow the Nos. lifting to stand on the parapet raised out of the trunnion holes till high enough to allow a 3-inch flat piece (3' x 6" x 3") to lie on the top of each bracket, across the trunnion hole, and under the trunnion. This gives room for the long skids to be launched well up. (*Vide Fig. 6.*)

Mounting and Dismounting Guns (64-Pr.).

Section I.

Care should be taken to ensure these skids being similarly placed under each trunnion so that in dismounting the gun both go clear of the trunnions at the same time. The gun must be run back to the rear stops before dismounting.

Fig. 6.



The long skids may be secured by means of dragropes hooked into the grummetts at the upper ends, on the outside, made fast to the front eyebolts of the platform and then frapped. Luff tackles hooked into the grummetts and eyebolts, instead of the dragropes, answer very well.

Should any difficulty be experienced in starting the gun down the watered skids, the hauling power may readily be doubled by passing the rope used through a snatch block made fast with a selvagee to the breeching loop, the standing end being secured to a holdfast. By applying a "runner" tackle to the running end of the rope further large increase of power may be obtained.

Sometimes from the ground falling away in rear of the platform, it may happen with a Dwarf Traversing Platform, that the lower ends of the long skids cannot be supported on the ground—in which case they may either be supported on skidding, or the platform may be raised in front and skidded up, which will cause the lower ends of the long skids, when in position, to come down.

With guns mounted on traversing platforms in "barbette" batteries, it is sometimes convenient to parbuckle the gun from its carriage on to the parapet.

The operation calls for no special remark.

To Mount the Gun

Is the converse of the foregoing, and closely resembles the like operation on a garrison standing carriage.

When the gun is high enough, the trunnions should be received on a 6-inch piece in each trunnion hole, the muzzle is then borne down, the long skids cleared away, and the gun lowered into the trunnion holes.

Section I.

Mounting and Dismounting Guns (64-Pr.).

SHIFTS.

TO SHIFT A 64-PR. R.M.L. GUN FROM ONE GARRISON
STANDING CARRIAGE TO ANOTHER, MUZZLE OR BREECH
FOREMOST.

Strength of Detachment, 19 Nos.

Stores required.

Drag ropes, heavy	2
Handspikes, common, 6-foot	8
Lashings, 1½-in., 3 fms.	2
Plank, fir, whole, 10' x 17" x 3" ..	1
Rollers, shifting, sabicu, 14" x 5" ..	2
Scotches, of sorts	12
Skids, oak, 3' x 4" x 4"	3

In carrying out this operation muzzle first, unless great care be taken to keep the gun well in hand, it is liable to overshoot the breast of the carriage on to which it is travelling and so dismount itself, and do damage or cause an accident; it is therefore, as a rule, better to carry out this shift breech foremost.

Raise the gun out of the trunnion holes.

Fix steadying handspikes, breech and muzzle drag ropes.

Place plank and rollers.

Taut. Heave. Halt.

"*Raise the gun out of the trunnion holes.*"—The gun is raised out of the trunnion holes till high enough to rest on the 4-inch piece placed through both trunnion holes, the breech resting on a 4-inch piece placed on the top step of the carriage, with a small scotch under each end of it. (*Vide Fig. 4, page 525.*)

The spare carriage is placed close in rear of the one on which the gun is mounted, and the trucks scotched up.

"*Fix steadying handspikes, breech, and muzzle drag ropes.*"—8 and 9 fix steadying handspikes, 10 and 11 muzzle and breech drag ropes.

"*Place plank and rollers.*"—10 and 11 place the plank to rest fairly on the front transom of each carriage, and support it further by placing the stool beds across the second steps of both carriages. The muzzle is borne down and rear roller placed, first, just in rear of the centre of gravity, the breech lowered on to it, and scotched up, front, rear, and on top; this gives a very light lift for the muzzle, which is then raised, and the muzzle roller placed just in front of the centre of gravity; the gun is lowered on to it and scotched up as before. The muzzle is again borne down, and the breech roller run back until it lies halfway between the two boss-headed bolts in rear of the trunnion holes of the two carriages.

The steadying handspikes should be manned during the operation of placing rollers and moving the gun.

Breech and muzzle drag ropes are now manned, and the gun hauled to the rear till its trunnions are over the trunnion holes of the spare carriage.

Mounting and Dismounting Guns (64-Pr.).

Section I.

To clear away plank and rollers the muzzle is lifted and a 4-inch piece placed through both trunnion holes, the gun lowered on to it and scotched up. The muzzle is then borne down, the breech roller and plank removed, and the breech lowered on to a 4-inch piece across the top steps.

On the old carriage being removed the gun is ready for lowering into trunnion holes. Shifting from carriage to carriage muzzle foremost calls for no further remark, beyond that for the reasons before pointed out it must be done with caution.

TO SHIFT FROM A GARRISON STANDING CARRIAGE TO ANOTHER BY SLEWING.

Strength of Detachment, 19 Nos.

Stores required.

Handspikes, common, 6-foot	8
Scotches, of sorts	12
Skids, 3' x 4" x 4"	3

RAISE THE GUN OUT OF THE TRUNNION HOLES.

Lift and slew.

Bear down and slew.

The gun is raised out of the trunnion holes and supported on two 4-inch skids, one through the trunnion holes, the other across the top step of the carriage. The spare carriage is then placed close alongside the other, so that the trunnion holes are opposite, and trucks scotched up.

"*Lift and slew.*"—The muzzle is lifted and carried towards the spare carriage; and at "*Bear down and slew*" the muzzle is borne down and the breech moved in the same direction, and so on, shifting the short skids as required, first to bridge over the interval between the carriages, and afterwards to support the gun on the spare carriage.

Care must be taken at all times to keep the gun so supported that the trunnions are rather in rear of the trunnion holes. This is a very simple and expeditious method of shifting the gun; but requires to be very carefully carried out, the muzzle being invariably moved first.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON OR FROM A MONCRIEFF CARRIAGE.

Strength of Detachment, 19 Nos.

Stores required.

Drag ropes, heavy	4
Gyn, 18-foot light, complete.. .. .	1*
Handspikes, common, 6-foot.. .. .	8

* Should it also be required to dismount the elevator (which weighs nearly 9 tons), it will be necessary to employ an 18-foot heavy gyn.

Section I. Mounting and Dismounting Guns (64-Pr.).

Lashings, 2½-inch tarred rope, 5 fathoms each ..	4
„ 1½-inch white or tarred, 3 fathoms each .	4
Levers, 12-foot	2
Planks, fir, whole, 10' x 17" x 3"	4
„ oak, half 6' x 12" x 3'	4
„ „ „ 4' x 12" x 3"	4
Rollers, ground, elm, 6" x 6'	1
„ „ „ 3' x 6"	3
Scotches, of sorts	20
Selvagees	4
Skids, fir, 6' x 12" x 12"	2
„ „ 4' x 12" x 12"	2
„ oak, 3' x 9" x 6"	4
„ „ 3' x 6" x 6"	4
„ „ 3' x 6" x 3"	4
„ „ 3' x 4" x 4"	4
Slings, gun, white rope, 6-inch, 12 feet long ..	1
Tackles, luff, complete	2
„ gun, heavy	1
Yarn, spun, lbs.	1

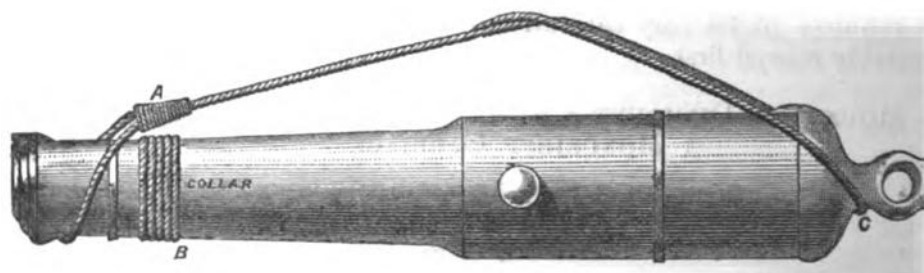
To Dismount the Gun and Elevator.

Having run back, or lowered elevator into loading position, place gyn with small splay, with its head a few inches in rear of the centre of gravity of gun.

As a fid in the bore cannot be used for want of room, the sling (6-inch, 12 feet long) may be attached in the following manner.

One bight of the sling is passed under the muzzle and the two returns strongly lashed together at A close down to the gun. A collar of lashing is then applied round the chase at B to prevent the sling from slipping towards the trunnions. The other bight of the sling is passed under the neck of the cascable at C. Fig. 7.

Fig. 7.



Before raising the gun out of the trunnion holes, capsquares, and elevating bar are removed, and the elevator supported under the counterweight with skidding placed on and across the platform, Fig. 8.

Mounting and Dismounting Guns (64-Pr.).

Section I.

The gun should be slung somewhat breech heavy, to aid its clearing the elevator. Planks or skidding may be placed under the feet of the cheeks and pry-pole of the gyn to increase the lift when necessary.

The feet of the gyn must be lashed as usual. A chain strap of $\frac{3}{4}$ -inch short link iron chain about 5 fathoms long may, if procurable, be employed with advantage to sling the gun, the point of suspension being as close down to the gun as possible, and the ends made fast with a reef knot: being free from stretch it will economise lift. It is applied in the same way as the rope sling.

The gun is raised out of trunnion holes, the platform traversed clear and the gun lowered and removed.

To Dismount the Elevator.

Remove all fittings connecting elevator to platform. The elevator may be slung as shown in Fig. 8, the same sling which was used with the gun being applied at A. If a rope sling is employed, it must be protected by serving, sandbags, or hemp-waste, where it bears against the edges of iron work.

The head of the 18-foot heavy gyn should be placed over the centre of gravity, which lies about six inches in rear of the point A, fig. 8, and a 16-foot light gyn tackle or heavy gun tackle be made use of to suspend the rear of the elevator: the treble block of this tackle is secured by a selvagee or lashing to the head of the gyn or hooked to the shackle, and the double block in like manner to a 6-inch ground roller, placed through the trunnion holes and kept there by the capsquares.

A chain strap instead of the sling at A economises lift.

The weight of the elevator is about $8\frac{1}{4}$ tons, nearly all of which falls on the front point of suspension at A.

As the heavy gyn tackle will have to take nearly all the weight, the slack must be well got in and a good strain put on it first; then haul in the slack of the other tackle and take three turns round the gyn windlass with the running end of the fall: when the gyn levers are worked, the windlass takes in the running ends of both tackles, and thus raises the elevator in a horizontal position clear of the platform.

The platform is raised off its pivot and removed; this may be done in the same way that an ordinary traversing platform is moved, *vide* page 598. When the platform is clear, the elevator is lowered on to skidding, or removed on a sleigh, as required; if the latter, it should be lowered with the gyn tackles, in a horizontal position, and so skidded on the sleigh.

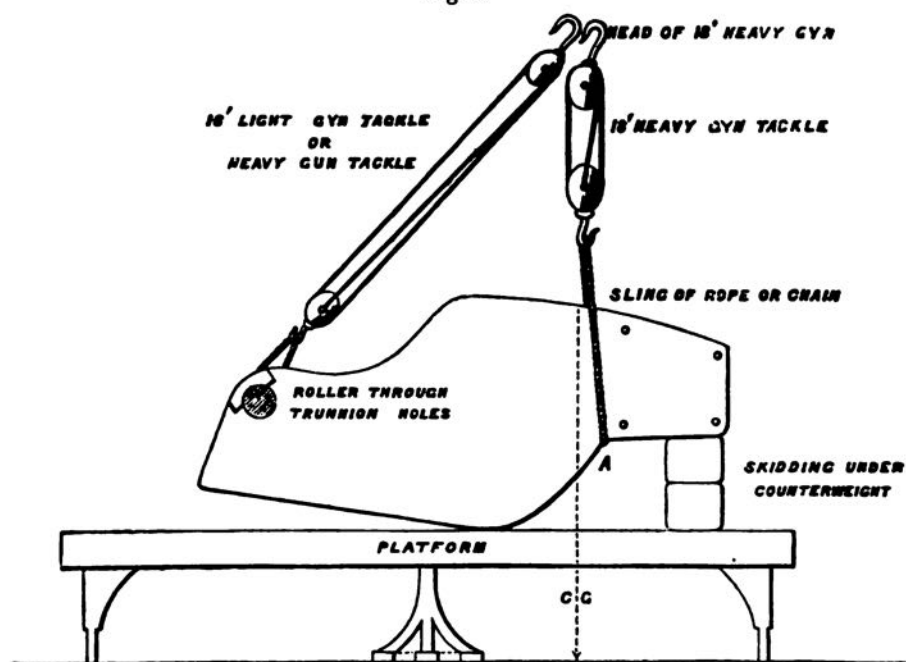
To Mount Gun, Elevator and Platform.

Is the converse of the foregoing.

Section I.

Mounting and Dismounting Guns (64-Pr.).

Fig. 8.



Mode of slinging elevator of 64-pr. R.M.L. gun mounted on Moncrieff carriage.

MOUNTING AND DISMOUNTING IN CASEMATES.

Instances occur when 64-pr. guns are found in covered-in works, such as the galleries at Gibraltar, mounted on garrison standing carriages, in which case the following methods of mounting and dismounting them will probably be available:—

1. By Gibraltar gyn.
2. By long skids, watered, up or down the rear.
3. Do. with rollers, do.
4. Do. parbuckling up or down the side.

If space is confined, the first method may have to be resorted to; fully described under "Machines."

Should there be room, any one of the above methods may be adopted as most convenient.

Should there be overhead bolts, the mode of procedure will be found described in the following pages when treating of 64-pr. R.M.L. guns mounted on traversing platforms in casemated works.

When guns of this nature are mounted on traversing platforms in casemated works, they will probably be mounted or dismounted by one of the two following methods:—

Mounting and Dismounting Guns (64-Pr.).**Section I.**

1. By overhead tackles.
2. By skids, 20 feet by 9 inches by 9 inches, watered, up or down the rear.

Local circumstances can alone govern the method it will be most advisable to follow.

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN ON OR FROM A TRAVERSING PLATFORM IN A CASEMATED WORK, PROVIDED WITH OVERHEAD BOLTS, WITH TACKLES.

Strength of Detachment, 19 Nos.

Stores required.

16-foot light gyn tackles, complete	2
Luff tackles, complete	2
Lashings, white or tarred, 2½-inch rope, 5 fms. each	2
Drag ropes, heavy	2
Scotches	12
Selvagees	4
Blocks, 10-inch single or snatch	2
Yarn, spun, lbs.	1

Should the stores not be on the gun, two truck levers will be required.

To Dismount the Gun.

Traverse the platform into the centre of the casemate; run the gun back until the breeching loop lies immediately under the rear overhead bolt, into which the treble block of one gyn tackle is hooked, its double block being securely lashed to the cascable.

The other gyn tackle is hooked in like manner to the front overhead bolt, and its lower or double block lashed to the gun or to a fid in the bore, according as the tackle hangs when overhauled.

The gun being elevated to the full extent, the slack of the muzzle tackle is taken in and the fall made fast; the breech is then raised till the trunnions are clear, when the carriage is run up, the platform traversed clear, and the gun lowered on to skidding. Unless crabs are employed to take in the running ends of the overhead tackles, the requisite amount of power will probably have to be obtained by means of luff tackle runners.

It should be borne in mind that there is very little lifting and a good deal of lowering to be done; the operation should therefore be commenced with the luff tackles nearly rounded in, and with their double blocks sufficiently far from the upper blocks of the overhead tackles to enable the gun to be lowered without having to skid up and re-adjust tackles.

To Mount the Gun.

This being the exact converse of the foregoing need not be described.

(A. M.)

2 M

Section I.

Mounting and Dismounting Guns (80-Pr.).

TO MOUNT OR DISMOUNT A 64-PR. R.M.L. GUN BY MEANS OF LONG SKIDS, WATERED, UP OR DOWN THE REAR.

This will be found described at page 530, under "Open Works," the operations being identical, but there would seldom be room enough to carry it out in a casemate.

80-PR. R.M.L. GUNS.

Mounting and dismounting the 80-pr. on or from traversing platforms, whether in open batteries or casemated works, is precisely similar to the method already described for the 64-pr. R.M.L. gun, except as regards the raising out of, or lowering into, trunnion holes, which is effected as follows:—

TO RAISE 80-PR. R.M.L. GUNS ON A TRAVERSING PLATFORM OUT OF THE TRUNNION HOLES, AND THE CONVERSE.

Strength of Detachment, 19 Nos.

Stores required.

Hammer, claw	..	..	..	..	1
Handspikes, common, 7-ft.	..	..	..	..	8
Lever, 12-ft.	..	..	..	..	1
Prisms	..	..	..	..	1
Skids, oak, 3' x 9" x 6"	..	..	..	..	4
Do. do. 3' x 6" x 6"	..	..	..	..	4
Do. do. 3' x 6" x 3"	..	..	..	..	4
Do. do. 3' x 4" x 4"	..	..	..	..	4
Scotches, of sorts	..	..	..	..	20

Raise the Gun out of the trunnion holes.

Prepare to bear down the muzzle.

Bear down.

Come up.

Prepare to lift.

Lift.

Lower.

"*Raise the Gun out of the trunnion holes.*" "*Prepare to bear down the muzzle.*"—Nos. 2 and 3 place a lever in the bore, double manned by 4, 5, 8, 9, 10 and 11; 12 passes a handspike across the lever, close to the muzzle, to 13; this is double manned by 14 and 15; 16 a handspike over the neck of the muzzle to 17, which is double manned by 18 and 19.

"*Bear down.*"—The whole bear down, Nos. 6 and 7 remove the elevating screw and coins; 6 and 7 then place two 6" x 9" skids between the cheeks of the carriage, their ends resting on blocks, scotches, or prisms, to keep them clear of the stay bolt, (Fig. 9), and a prism or two large coins (if a prism should not be available) placed a little behind the centre of gravity at right angles to the skidding. (*Vide* Fig. 9.)

Mounting and Dismounting Guns (80-Pr.).

Section I.

"*Come up.*"—The breech is allowed to rest on the prism, and scotched up by Nos. 6 and 7.

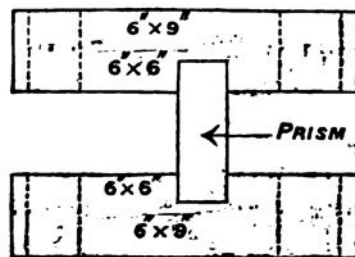
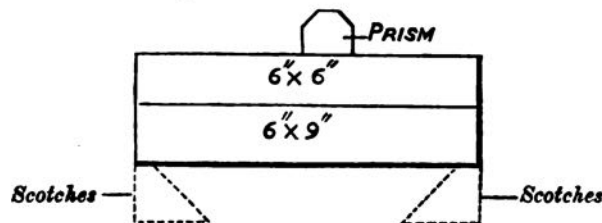
"*Prepare to lift.*"—Nos. 12 and 16 shift their handspikes underneath.

"*Lift.*"—The Nos. lift the gun, and 6 and 7 place a 4-inch skid in each trunnion hole.

"*Lower.*"—The gun is lowered until the trunnions rest on the skids.

The operation is continued by alternately bearing down and lifting the muzzle, and placing skidding under the breech and trunnions until the gun is sufficiently high for a flat 3-inch piece to be placed under the trunnions across each trunnion hole. (*Vide* Fig. 6, p. 531.)

Fig. 9.

Plan.*Side Elevation.*

TO LOWER INTO TRUNNION HOLES

Is the exact converse of the foregoing.

In mounting or dismounting with long skids, they should, if much worn, receive intermediate support.

7-INCH R.B.L. GUNS OF 82 CWT. AND 72 CWT.

The operations of mounting and dismounting guns of these natures, when mounted on traversing platforms in open batteries or casemated works, are precisely similar to those described for the 64-pr. and 80-pr. R.M.L. Gun.

(A. M.)

2 M 2

Section I.

Mounting and Dismounting Guns (7-inch B.L.).

The only additional stores required are, a punch to remove the keep pins from the breech fittings, and when working with overhead tackles, a fid for the breech screw as well as the muzzle is sometimes required. In raising out of trunnion holes, the fulcrum for the breech is most conveniently placed under the strengthening coil, or with a 72-cwt. gun in a corresponding position.

In hauling the gun down watered skids, a handy method of making fast the rope will be found to be through the breech screw and vent slot.

Before mounting or dismounting these guns, the vent piece, lever, tappet and indicator rings should be removed, in addition to the sights, elevating screw, &c.

GENERAL OBSERVATIONS ON MOUNTING AND DISMOUNTING
THE HEAVIER NATURES, FROM THE 7-INCH R.M.L. AND
UPWARDS.

The 7-inch R.M.L. gun of 7 tons is the heaviest gun that can be raised by one 18-foot light gyn in a clean lift, and the 9-inch R.M.L. gun of 12 tons the heaviest that can be raised in like manner by one 18-foot heavy gyn, but at the same time it is perfectly practicable, as will be seen from the following pages, to mount and dismount 12 or 18-ton guns by using one 18-foot light gyn at the cascable to raise the breech, and a jack to raise the muzzle, or to mount 25-ton guns in the same way with an 18-foot heavy gyn and jack.

In such cases it is always possible to regulate the weight that has to be raised at breech or muzzle, by placing the skidding, which forms the fulcrum, round which the gun revolves in rising, closer to, or further from, the centre of gravity, which may be taken, with all the heavier natures, to lie in the axis of the trunnions. Full instructions will be found at page 434, and following as to the mode of calculating the "lift" in any case, or the weight that will have to be taken by any supporting beam or skid. The calculations referred to have purposely been made of so simple a nature as to fall well within the comprehension of anyone likely to be entrusted with the carrying out a heavy operation. There should, therefore, now be no excuse for tackles, jacks, beams, or skids ever being subjected to a greater strain than that which they are calculated to take with safety, a proceeding invariably attended with danger, or at least liable to lead to destruction of material.

Speaking generally, the following are the main points to be attended to by the officer in charge.

He should explain to the detachment, before commencing the work, the manner in which it is proposed to carry it out. If this can be effected with the aid of rough models, so much the better.

Mounting and Dismounting Guns.

Section I.

He should examine carefully the whole of the materials and gear before using them.

The men should be out of positions of danger, such as under a suspended weight, in the bight of a rope running through a leading block, from treading on a fall when taut.

A check rope or tackle should always be used if there is a possibility of a weight fetching away.

The axis of a gun resting on skidding should never be, as a rule, more than 3° out of the horizontal.

The greatest stability should be given to skidding, if of any height, by "cross-building" it.

A weight should always be followed up with scotches and skidding.

With all heavy guns, the general principles that govern the mode of procedure are the same.

In the following pages the 9-inch R.M.L. gun of 12 tons has been taken as a type, and the operations with it somewhat fully described, so as to serve for guidance in dealing with other natures. It has not therefore been thought necessary to treat at length concerning mounting and dismounting guns of 7, 18, and 25 tons either in open or casemated batteries.

Wherever sights or elevating patches are removed, the sockets or holes should be filled with waste to keep out dirt, unless the preserving screws are used.

The exact amount of the elevating and traversing or running back gear which it may be advisable to remove before carrying out any operation, cannot be laid down, as the fittings of the various natures and patterns differ. This must be left to the discretion of the officer conducting the operation, but all fittings liable to injury in the work should invariably be removed.

All screws and other fittings should invariably be well cleaned and lubricated before being fixed or replaced. This is especially necessary on sea fronts.

The following stores will be found useful in removing or replacing fittings:—

Hammer, claw	1
Spanners, Mac Mahon	2
Wrench, knockup	1
Oil in can and waste	1
File, half round (for removing burrs)	1
Turnscrew	1
Punch, steel (for removing keep pins)	1
Key, for removing arcs	1
Wrench, iron, with clamp, for ditto	1

Section I. Mounting and Dismounting Guns (7-inch R.M.L.).

7-INCH R.M.L. GUN OF 7 TONS.

OPEN BATTERIES.

The 7-inch R.M.L. gun of 7 tons may be met with in open batteries mounted on dwarf or casemate traversing platforms or Moncrieff carriages.

When on traversing platforms, they may be mounted or dismounted by either the heavy or light 18-foot gyn, and may be dismounted by long skids down the rear.

They can on an emergency be mounted by the latter method, but it is to be avoided if possible, being very heavy work and destructive to the shells of the blocks employed in the operation.

TO MOUNT OR DISMOUNT A 7-INCH R.M.L. GUN OF 7 TONS,
MOUNTED ON A DWARF OR CASEMATE TRAVERSING PLAT-
FORM, BY MEANS OF AN 18-FOOT GYN (HEAVY OR LIGHT).

This operation calls for no special remark.

The gun should be slung with a 7-inch white rope sling 14 feet 6 in. long.

The position of the gyn with reference to the particular nature of pivot and the mode of conducting the operation, are the same as described for the 64-pr. R.M.L. gun. (*Vide* page 472, *et seq.*)

TO DISMOUNT A 7-INCH R.M.L. GUN OF 7 TONS, MOUNTED ON
A DWARF OR CASEMATE TRAVERSING PLATFORM, BY LONG
SKIDS (20' × 9" × 9") DOWN THE REAR.

This operation is nearly identical with the like operation with a 64-pr. R.M.L. gun described at page 530, but if the gun is to be raised out of the trunnion holes by means of a lever, the following points of difference are to be observed:—

Strength of Detachment, 25 Nos.

Stores required.

Blocks, 15-inch, single or snatch	..	..	..	1
Dragropes, heavy	..	..	..	2
Handspikes, common, 7-foot	..	..	..	8
Lashings, white or tarred, 2½-inch, 5 fathoms each.	..	..	..	4
Levers, 14-foot.	..	..	..	2
Luff tackles, complete	..	..	..	2
Planks, oak, half, 4' × 12" × 3"	..	..	..	2
„ fir, whole, 10' × 17" × 3"	..	..	..	2
Roller, ground, elm, 6" × 3"	..	..	..	1
Rope, parbuckle, 4½-inch tarred	..	..	..	1
Scotches of sorts	..	..	..	20

Mounting and Dismounting Guns (7-inch R.M.L.).

Section I.

Skids, fir, 20' x 9" x 9"	..	..	..	..	2
" " 6' x 12" x 12"	..	..	..	..	6
" " 4' x 12" x 12"	..	..	..	..	6
" oak, 3' x 9" x 6"	..	..	..	..	6
" " 3' x 6" x 6"	..	..	..	..	6
" " 3' x 6" x 3"	..	..	..	..	6
" " 3' x 4" x 4"	..	..	..	..	6
Prism ..	..	..	..	..	1
Selvagees ..	..	..	..	..	2
Water bucket, filled, and brush	..	..	..	..	1

N.B.—This list is framed for the dwarf traversing platform, and allows for skidding up under the front of the platform when raised, under the rear when lowered by the removal of the rear trucks and for giving intermediate support to the long skids, supporting their lower extremities and raising the ground roller off the ground.

For the casemate platform a smaller estimate of short skidding would be admissible.

To enable the lower ends of the long skids, when in position, to approach the ground (in the case of a dwarf traversing platform) the following steps may be taken:—

Run the gun up to the front stops, raise the rear of the platform with two 14-foot levers (or jack), remove rear trucks, and lower rear of platform until the iron flanges that carry the trucks are close to the ground, and skid up on securely built skidding; then having run back to the rear stops, raised the gun out of the trunnion holes, and got the long skids into position, raise the front of the platform until the lower extremities of the long skids approach within a convenient distance of the ground; support their lower ends, and also skid up under them close in rear of the platform. Assist to cradle them by jamming in large scotches at every point where they bear (except the front transom of the carriage).

To raise the Gun out of the Trunnion holes by Lever.

The foregoing list of stores need not be rigidly adhered to, but is given as an example. The same may also be said of the arrangement of the skids, and the words of command.

Depress and remove elevating gear.

Build up under breech.

Come up.

Prepare to lift.

Lift.

Lower.

Bear down the muzzle.

"*Depress and remove elevating gear.*" Nos. 8 and 9 place a lever over the muzzle, and, assisted by the other Nos., bear down. The first seven Nos. remove the sights, elevating gear, capsquares, and other fittings.

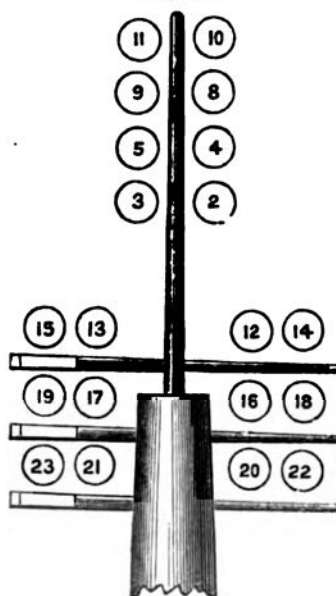
Section I. Mounting and Dismounting Guns (7-inch R.M.L.).

"Build up under breech." Nos. 6 and 7 arrange three 3' x 6" x 9" skids under the breech of the gun so as to give a firm bearing, but they must not rest on the compressor bolt. A prism is placed on the top of the skids about 18 inches in rear of the centre of gravity.

"Come up." The breech of the gun is allowed to rest on the prism, and a scotch jammed in on each side.

"Prepare to lift." Nos. 2 and 3 place a lever in the bore, which is manned by 4, 5, 8, 9, 10, and 11. No. 12 passes a handspike under the lever to 13, double-manned by 14 and 15; 16 one in rear of 12's under the muzzle to 17 double-manned by 18 and 19; 20 one in rear of 16's to 21 double-manned by 22 and 23. All the Nos. face to the rear. (Fig. 10.)

Fig. 10.



"Lift." The Nos. lift the muzzle; Nos. 6 and 7 first jam in scotches under the trunnions, and as soon as possible get in a skid. The skid cannot always be got under the trunnions at the first lift, but the gun can rest on scotches in the trunnion holes, whilst the Nos. prepare for a second or third lift. If the support under the breech is unsteady, the gun will roll and increase the difficulty of the operation. In that case it is best to lower the gun and readjust the skids under the breech.

"Lower."—The gun is lowered.

"Bear down the muzzle."—The Nos. at the muzzle bear down. Nos. 6 and 7 raise the point of support under the breech by placing two additional skids. The Nos. at the muzzle now lift again, Nos. 6 and 7 skidding up under the trunnions until the gun is high enough. (Vide Fig. 6, page 531).

The 15-inch snatch block is now made fast to the breeching loop, the 4½-inch parbuckle rope rove through it, its standing end being

Mounting and Dismounting Guns (7-inch R.M.L.).**Section I.**

secured to a holdfast in rear, and a heavy gun tackle or light gyn tackle applied to its running end; the gun is thus hauled down the watered skids on to the ground roller placed to receive the breech.

A 10 or 12-ton jack may be used to raise the muzzle instead of a lever.

In a barbette battery it is more convenient to raise the gun out of the trunnion holes when run up to the front stops, and run back afterwards.

**TO MOUNT OR DISMOUNT A 7-INCH R.M.L. GUN OF 7 TONS
ON OR FROM A MONCRIEFF CARRIAGE.**

With a Mark I. or old pattern carriage, it is practicable, in some cases, to dismount the gun from the firing position on to the parapet in front, in the following manner:—

The gun is raised out of the trunnion holes till high enough to place two 14' × 8" × 8" fir skids under it, one end of the skids resting on the parapet, the other on the breast of the gun carriage; the skids are lashed to prevent their moving, cradled and watered, and the gun is moved by means of tackles on to the parapet. Mounting is the converse.

The elevating fittings should be removed before raising out of trunnion holes.

The following description gives an idea of the method to be followed to place a Mark II. 7-inch Moncrieff platform, carriage and elevator (in one) in position, and in mounting the gun.

The platform, which weighs about 5 tons, is first brought into the emplacement on an extemporised sleigh, formed by placing fir skids, 20' × 9" × 9", under it fore and aft, short skidding being placed between the long skids and the platform to enable the ground rollers on which the platform is moved to clear the under surfaces of the trucks. The platform is then lowered on to the racers. The elevator, which weighs about 14½ tons, would be then brought alongside the platform on a heavy sleigh, having been previously placed on the sleigh in a horizontal position (or, in other words, nearly in the position the elevator assumes after recoil). Fig 11.

Sheers, capable of raising 15 tons, would then be rigged and raised in such a position that their head when vertical would come about over the middle of the elevator, which would be slung as shown in Fig. 11.

The elevator is then raised, the sleigh run back, the platform traversed under, and the elevator lowered into position. It is then skidded up across the platform, under the counterweight, and unslung.

The gun having been brought into a convenient position, is raised by the sheers and lowered into the trunnion holes.

Dismounting would be the converse of this.

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

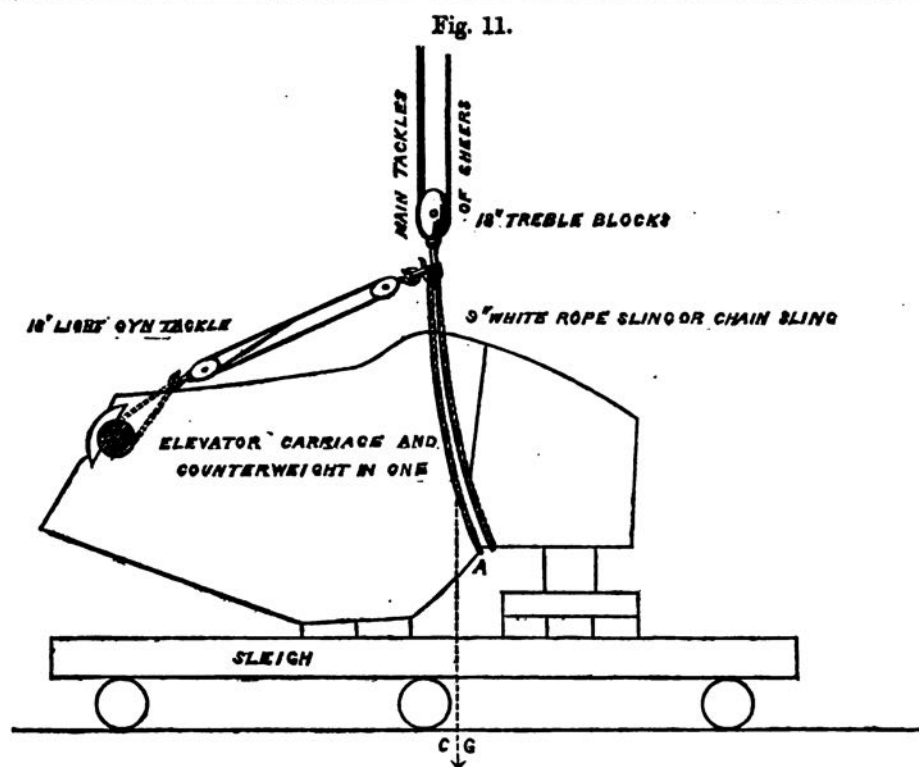


Fig. 11 represents Mark II. 7-inch R.M.L. Moncrieff elevator carriage and counterweight on a sleigh, ready for raising with sheers, being slung with two 9-inch white rope gun slings, each 16 feet long, or by a chain sling at A, and by an 18-foot light gyn tackle; the lower block of the gyn tackle being strongly lashed with a 3-inch lashing to a roller passed through both trunnion holes, and the upper block in like manner to the hooks of the two lower blocks of the two main tackles of the sheers.

If rope slings are used, care must be taken to prevent their being cut by the iron edges of the elevator by interposing sand bags, or by other means, at the points of bearing. If only one main tackle is employed to raise the elevator, a "messenger," should be used on the running end of the fall.

7-INCH R.M.L. GUN OF 7 TONS IN CASEMATES.

The various methods of mounting or dismounting the 7-inch R.M.L. gun in casemates are so nearly identical with those described at length for the 9-inch R.M.L. gun of 12 tons, as to call for no special remarks.

9-INCH R.M.L. GUN OF 12 TONS.

OPEN BATTERIES.

These guns may be met with in open batteries mounted on casemate traversing platforms behind iron shields, and on dwarf

Mounting and Dismounting Guns (9-inch R.M.L.).**Section I.**

traversing platforms "en barbette," either behind parapets or in "C" emplacements.

When mounted behind shields the platform will always have an A or imaginary pivot, lying 4 feet 4½ inches in front of the breast of the platform (with this nature of gun); but when mounted "en barbette" the platform will generally have either a "C" pivot, which is an actual pivot in its centre, or a D pivot, which is also an actual pivot, placed between the centre and rear of the platform.

These guns, as a rule, are always mounted or dismounted in open batteries, by either one 18-foot heavy gyn or by means of one or two 18-foot light gyns, as hereafter described. Should, however, no gyn be available, the operations could be performed by using jacks under a beam lashed to the cascable, as described at page 560.

The exact method pursued in dismounting a gun will depend on the object in view; for instance, should it only be required to remove the carriage, or the carriage and platform, it might be done as follows:—

TO REMOVE CARRIAGE, OR CARRIAGE AND PLATFORM.

The sights, capsquares, and elevating arcs are removed, the gun run up to the front stops, elevated, skidded up under the "B" tube or chase near the half-weight mark, either on the parapet or in the port, and scotched. An 18-foot gyn, heavy or light, is then placed over the cascable, to which the lower block of the gyn tackle is secured, either by a short 9-inch sling or by a stout lashing, such as a drag rope, and the breech raised with the gyn, till the trunnions are clear of the trunnion holes. Should it be necessary during the operation to increase the height of the muzzle skidding, the trunnions may be lowered on to oak skidding in the trunnion holes, the gyn tackle overhauled, and the muzzle raised sufficiently for the purpose, when the breech is again raised with the gyn till high enough, and the carriage run back and removed, as described at page 598, or both carriage and platform removed, see page 601.

This is a very good method, requiring but little skidding, and affording a very stable support at the muzzle.

**TO MOUNT OR DISMOUNT A 9-INCH 12-TON GUN ON OR FROM
A DWARF OR CASEMATE TRAVERSING PLATFORM, ANY
PIVOT, USING ONE 18-FOOT LIGHT GYN AT THE BREECH
AND A JACK OR LEVERS AT THE MUZZLE.**

Strength of Detachment, 13 Nos.

Stores required.

Drag ropes, heavy .. .. .	..	..
Gyn, 18-foot, light, with stores complete ..	..	..

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

Handspikes, common, 7-foot	8
Jacks, lifting, hydraulic, 10 or 12 tons	1
Lever, 14-foot	1
Luff tackles, complete	2
Planks, fir, whole, 10' x 17" x 3"	4
Parbuckle ropes, 4½ inches, tarred	2
Roller, shifting, sabicu, 2' x 5"	1
Scotches, of sorts	12
Skids, fir, 6' x 12" x 12"	6
" " 20' x 9" x 9"	2
" " 4' x 12" x 12"	6
" oak 3' x 9" x 6"	6
" " 3' x 6" x 6"	6
" " 3' x 6" x 3"	4
" " 3' x 4" x 4"	4
Slings, gun, 9-inch white rope, 3 feet, with thimble	1

To Dismount the Gun.

The gun is run back until the muzzle falls a little inside the shield or work, the sights, capsquares, elevating arcs, and patches are removed. The gun is elevated and a fulcrum of cross-built skidding arranged on and across the platform, built up under the short coil, which is scotched up. The breech is raised with gyn, as before, till high enough to run the carriage back clear of the gun. To do this it will probably be necessary to run back until the rear of the carriage overhangs the rear of the platform, or dismount it altogether. The breech is lowered with the gyn (until the gun has an elevation of about 3°) on to skidding placed across the platform to receive it, and scotched up. The muzzle is raised by jack or levers (the gyn tackle being overhauled), the height of the skidding under the short coil reduced and the gun lowered, until it has about 3° depression, when the breech is lowered with the gyn as before, and so on, until the gun is lowered to the extent required, when, the gyn having been removed, it is parbuckled either down inclined skids, or on the horizontal, or placed on a sleigh, as required; or the gyn may be left standing, the platform with carriage on it be run to the rear on temporary sleigh, when a sleigh having been run under the gun, it is lowered on to it with gyn and jack and so removed.

To Mount the Gun

Is the exact converse of the foregoing, but the following points should be observed:—

It is sometimes inconvenient from want of space to parbuckle a gun on long inclined skids up on to a platform, in which case the gun may be brought alongside the platform and raised with jack or levers, breech and muzzle alternately, till high enough to be rolled horizontally on to receiving skids placed across the platform; the trunnions are then, if necessary, slewed by gyn, jack, or levers,

Mounting and Dismounting Guns (9-inch R.M.L.).**Section I.**

to bring them horizontal, with the vent uppermost, the gun being exactly in the middle of the platform. Care should always be taken to roll the gun on to the platform, with the trunnions sufficiently far to the front to enable the trunnion holes of the carriage to be brought under them, when the gun is raised, and the carriage in position on the platform, with the flange clear of the buffer. Should this have been neglected it will be necessary to move the gun straight to the front on the platform, which may be effected as follows:—

**TO MOVE THE GUN WHEN SKIDDED ON ITS PLATFORM
STRAIGHT TO THE FRONT OR REAR, ON ROLLERS.**

Raise the breech with jack or lever, remove breech skid, substituting in its place a ground roller 8' x 12" (or two smaller rollers, 6' x 10", about 6 inches apart) just in rear of the centre of gravity, lower and scotch up, front, rear, and on top. Pass a 14-foot lever through the breeching loop and jam it with a few small wedges, apply a check tackle, for which a heavy gun tackle will answer, by means of a selvagee to the cascable, the standing block being made fast to a holdfast immediately in rear of the gun, haul in the slack and make fast. Raise muzzle and remove muzzle skidding, and lower on to a 6-foot or 8-foot ground roller 10 or 12 inches in diameter applied under the front part of the short coil, skids being placed fore and aft on the platform under each end of the roller to support it at the required height, and scotch up, front, rear, and on top. Make fast the single block of a luff tackle with a selvagee to each trunnion, and the double blocks to any convenient holdfast in front, such as a roller across the port. The gun is now ready to be hauled to the front, to do which, man steadying lever, luff and check tackles, unscotch all over, heave and ease off.

Since the gun moves to the front at twice the rate the rollers do, it is obvious that it may be moved twice the length of the short coil before the rollers require to be readjusted, and it would seldom be necessary to move it so far.

**TO MOUNT OR DISMOUNT A 9-INCH R.M.L. GUN OF 12 TONS,
ON OR FROM A DWARF OR CASEMATE TRAVERSING PLATFORM
"A" PIVOT, WITH AN 18-FOOT HEAVY GYN.**

Strength of Detachment, 19 Nos.

Stores required.

Drag ropes, heavy	4
Gyn, 18-foot, heavy, with stores complete	1
Scotches, of sorts	12
Skids, fir, 6' x 12" x 12"	2
„ oak, 3' x 9' x 6"	2
Sling, gun, 9-inch, white rope, 16 feet ..	1*

* Or the service chain sling described at page 550.

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

To Dismount the Gun.

The platform is traversed into a convenient position for placing and working the gyn, the gun run back to the rear stops, sights, capsquares, and elevating arcs and patches removed, and the gyn placed with its head over the centre of gravity of the gun, sufficient splay being given to admit of the platform being traversed over towards the prypole, when the gun is clear. Mounting the gun is the converse of the foregoing; but if when lowering the gun it is found that the trunnions fall just in rear of the trunnion holes when the carriage is run back as far as possible, the gun may be lowered till the trunnions rest on the carriage brackets, the trunnions be scotched up, and the breech supported on skidding placed on the bottom plate of the carriage. The gun is then unslung and moved the required distance to the front by running up the carriage; the gyn placed over the centre of gravity, the gun again slung and lifted clear, when the carriage is run back, and the operation completed.

For slinging the gun either a 9-inch white rope sling 16 feet long, or the chain sling described below, may be made use of; if the former is employed it should be applied with one bight under the cascable, the other under the chase, with one round turn, but it should be borne in mind that, in dismounting from a dwarf traversing platform, it is very likely from the stretching of the sling that the gyn tackle will be "chock-a-block" before the gun is clear of the trunnion holes. This may generally be remedied by placing one or more planks under each foot of the gyn.

When the chain sling is used it should be applied as follows:—

The breech sling is used at its full length.

The muzzle sling, with three short and one long link at each end hanging free; the large triangular link for the reception of the hook of the gyn tackle being attached to both breech and muzzle slings by a U shaped shackle bolt and screw nut.

The sling should be shackled upon the ground in the manner described, care being taken that the links lie fair and free from twist. The sling being hoisted up over the gun by the gyn tackle, the muzzle sling is first slipped over the muzzle and the bight (temporarily) brought back to near the breech coil, to enable the bight of the breech sling to be placed under the neck of the cascable; this done, the bight of the muzzle sling is placed at the intersection of the short coil and chase, and the slack taken in with the gyn tackle. (Fig. 12.)

Thus slung, the gun will hang horizontal. It is then raised out of the trunnion holes; when clear, the carriage is run up to the front stops, the platform traversed clear, and the gun lowered on to skids placed on the ground to receive it.

Section I.

A diagram showing a chain hoist assembly. A chain is attached to a hook at the top, which is connected to a central pulley system. The chain passes over the pulley and is attached to a hook at the bottom. The entire assembly is shown within a dashed rectangular frame, indicating its position relative to the container being lifted.

It is, however, sometimes convenient to resort to this method of raising the gun, to enable a drag, trolley, or sleigh to be run under it, or preparatory to building a temporary sleigh round it, especially if the trunnions are to be vertical.

Stores required.

Drag ropes, heavy	..	..	..	..	6
Gyns, 18-foot, light, with stores complete	..	..	..	..	2
Scotches, of sorts	..	..	..	..	12
Skids, fir, 6' x 12" x 12"	..	..	..	..	2
„ oak, 3' x 9" x 6"	..	..	..	..	2
Slings, gun, 9-inch, white rope, with thimble,	3 feet				1
„	7 feet				1
Roller, sabcu, 24" x 5"	..	..	..	..	1

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

To Dismount the Gun.

The stores required for the removal of the gun carriage, or of the carriage and platform, are not detailed, as they would depend on the work required to be performed.

The platform is traversed into a convenient position for placing and working the gyns, the gun run back to the rear stops, sights, capsquares, and elevating arcs and patches removed. The muzzle gyn is placed with its head over the half-weight mark, the breech gyn over the neck of the cascable, its cheeks being on the opposite side of the platform to that on which the cheeks of the muzzle gyn are situated; the 7-foot sling is used at the half-weight mark, and the 3-foot sling at the cascable, a small roller or a piece of wood being placed through the breeching loop to guard against the possibility of the sling becoming displaced.

When the gun has been raised high enough, the carriage is dismounted down the rear, or the carriage and platform moved to the rear on rollers from under the gun; the gun is then lowered on to skidding or sleigh, as required. The axis of the gun should be kept horizontal during the whole operation.

Mounting is the exact converse of this, but care must be taken to raise the gun with the trunnions horizontal, and far enough to the front to enable the trunnion holes of the carriage, when in position, to be brought under them.

**TO MOUNT OR DISMOUNT A 9-INCH R.M.L. GUN OF 12 TONS
ON OR FROM A DWARF TRAVERSING PLATFORM IN A "C"
EMPLACEMENT.**

In this case it is probable that the following will be found to be the most convenient mode.

To Mount the Gun.

The platform is assumed to be in position on its racers, and the carriage in any convenient position out of the way of the gun being parbuckled on to the platform in the manner hereafter described.

The strength of detachment and stores required will depend on the method employed to raise the gun.

The platform is traversed until it lies at right angles to a medial line passing through the centre of the emplacement, the gun parbuckled upon it (the muzzle being rather in front of the breast of the platform) on 20' x 15" x 15" skids, received on 6-foot skids and planks placed across the platform and scotched up. The long skids are then cleared away, and the platform traversed a quarter circle. The trunnions are now slewed, if necessary, by gyn, jack or levers till horizontal, the vent being uppermost. The gun is

Mounting and Dismounting Guns (9-inch R.M.L.).**Section I.**

now ready for raising, which may be effected by one 18-foot heavy gyn placed over the centre of gravity, or by an 18-foot light gyn at the breech, and jack at the muzzle, as described in the preceding pages.

When high enough, the carriage is mounted up the rear on 20' x 9" x 9" skids, and the gun lowered into the trunnion holes.

To Dismount the Gun.

Being the exact converse of the foregoing, need not be described.

To Remove the Carriage from under the Gun.

When a 9-inch gun is mounted in a "C" emplacement, and it is required to remove the carriage from under it, or to change it, it is most easily effected by skidding up under the gun, when elevated, under the short coil, the skidding being cross built on and across the platform; the breech is then raised with an 18-foot light gyn, and the trunnions received on a 6-inch piece in each trunnion hole, on which the gun is pivotted; the gyn tackle being overhauled, the skidding under the short coil raised, and another lift taken with the gyn; this should clear the gun from the carriage sufficiently to enable the latter to be dismounted down the rear.

Any required number of lifts may be taken in like manner by receiving the trunnions on oak skidding, and pivotting the gun on them, &c.

To Remove Carriage and Platform.

In this case the gun is run up to the front stops, elevated and skidded up under the chase; the skidding will probably have to be crossbuilt from the bottom of the sunken way, though it may be possible to get a bearing for the chase by skidding on the parapet in front; the gun is then raised with an 18-foot light gyn at the cascable, proceeding as in the preceding case, and when high enough, carriage and platform are removed to the rear.

TO DISMOUNT A 9-INCH R.M.L. GUN OF 12 TONS WITH LONG SKIDS DOWN THE REAR, FROM A CASEMATE TRAVERSING PLATFORM.

The 9-inch R.M.L. gun is the heaviest gun for which this method of dismounting may fairly be considered applicable.

The operation requiring much space, it may not always be practicable or convenient to carry it out.

(A. M.)

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Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

Strength of Detachment, 30 Nos.

Stores required.

Dragropes, heavy	2
Grease, Fenner's, lbs. .. .	1
Handspikes, common, 7-foot .. .	8
Jack, lifting, hydraulic, 10 or 12 tons .. .	1
Lever, 14-foot	1
Mauls	2
Planks, oak, 6' x 12" x 3" .. .	4
Coins, gun, large	2
Roller, ground, elm, 6' x 10" .. .	1
Scotches, of sorts	20
Selvagees	4
Skids, fir, 20' x 15" x 15" .. .	2
" 6' x 12" x 12" .. .	6
" 4' x 12" x 12" .. .	9
" oak 3' x 9" x 6" .. .	8
" 5' x 6" x 5" .. .	2
" 3' x 6" x 6" .. .	8
" 3' x 6" x 3" .. .	6
" 3' x 4" x 4" .. .	6
Tackles, luff, complete	3
" gyn, 18-foot, light, complete .. .	1
Water bucket, filled, and brush .. .	1
Yarn, spun, lbs.	1

The operation is here described for raising the muzzle by means of a jack, but it is practicable to do this by applying a 14-ft. lever on each side, if worked with a short counter lever, and with the breech skidded about 18 inches in rear of the centre of gravity, but the jack will be found most convenient.

The platform is traversed into a convenient position and scotched up, the gun run back to the rear stops, sights, fittings, capsquares, elevating arcs, patches and gear (except friction rollers) removed, also eccentric bar and gun-metal fittings for block of running back tackle. The gun is depressed by applying a lever across the chase, and a fulcrum of short oak skids built up between the brackets of the carriage under the rear part of the breech coil, on which the gun is scotched up. The muzzle is raised by applying a jack under it, following up with skidding placed across the platform, under the short coil, till high enough to insert a 6-inch piece under each trunnion. Then remove the upper skids from under the short coil, bear down the muzzle (the gun pivoting on the skids in the trunnion holes), and build up under the breech as before. Raise muzzle with jack till high enough for a 4-inch piece to be placed under each trunnion, across the trunnion holes, supported by a 6-inch piece in the trunnion hole. The gun is now high enough for placing the long skids.

Mounting and Dismounting Guns (9-inch R.M.L.).**Section I.**

Bear down muzzle, remove breech skidding, launch long skids up to front transom, and cradle them by means of two large coins placed with their points overlapping on the bottom plate of the carriage close to the front transom.* The long skids are further supported by skidding up under them close in rear of the platform, and under their lower ends, and cradled with scotches at every point of support. They are kept from moving by applying a strap across their lower extremities, into each bight of which the double block of a luff tackle is hooked, the single blocks being hooked into the rear eyebolts of the platform. The slack of both tackles hauled in and the falls made fast. A ground roller is arranged conveniently to receive the breech of the gun when it quits the long skids, which are well watered, and a little grease used to start the gun.

One block of a gyn tackle is made fast to the breeching loop, and the other to a holdfast in rear. A luff tackle may be applied to the running end of the fall if additional power is required.

The jack (worked up for lowering) is now applied under the muzzle, the trunnions raised off the supporting skids, which are removed, and the gun lowered on to the cradled skids, and hauled down them until the breech is received on the ground roller. In moving the gun on the roller a 14-foot lever placed through the breeching loop, and jammed with a few small wedges, serves to steady it.

IN CASEMATED WORKS.*General Observations.*

Exact rules cannot be laid down as to what methods are best to be followed in mounting and dismounting guns in casemates, as much will depend on the height of the casemate, whether fitted with overhead bolts of sufficient strength, the space available for working in, and the means at hand in the way of stores.

One of the following cases will, however, probably have to be dealt with:—

1. A casemate with overhead bolts, and of such a height as to enable the gun to be mounted, by lifting it clean up, with breech and muzzle tackles of the Yeatman's pattern, till high enough for the platform and carriage to be traversed under it.

2. A casemate with overhead bolts, as in Case 1, but Yeatman's tackles not available.

3. A casemate, either unprovided with overhead bolts, or fitted with light bolts, intended for a smaller nature of gun, and which cannot be utilized for lifting in this case.

Stores for running carriages, up or back, if not with the gun, must in every case be provided.

The foregoing three cases are treated on in the following pages, and the instructions given, or some slight modification of them, will probably be sufficient for any case likely to be encountered.

* By jacking up the front of the platform and skidding up as it rises, the lower ends of the long skids may, if desired, be brought nearer the ground.

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

In lowering into trunnion holes, unless the trunnions are kept perfectly horizontal, difficulty will be experienced from the square shoulders of the trunnions jamming between the brackets; this may often be remedied by applying the point of a 7-foot handspike or crowbar, as a lever, 1st order, under the lower trunnion, thus maintaining a strong upward pressure until the trunnions are fairly in the trunnion holes; or by jamming a scotch between the gun and brackets on the lower sides.

DESCRIPTION OF THE YEATMAN SYSTEM OF MOUNTING AND DISMOUNTING IN CASEMATES GUNS UP TO 25 TONS INCLUSIVE.

In order to get increased lift with the overhead tackles, both breech and muzzle, the swivel hooks and shackles are removed from the service blocks and re-placed by strong iron shackles, by means of which, in the case of the breech tackle, the upper block is secured to the rear overhead bolt, and the lower block to the breeching loop of the gun. Two muzzle tackles are employed, their upper blocks being secured by shackles to the front overhead bolt, and their lower blocks in like manner to the eyes at each end of the short wire rope strap or sling applied under the chase to raise the muzzle.

A drawing of this gear will be found in "Notes on Moving and Mounting 35 and 38-ton Guns," 1879. The falls of all three tackles are led away to iron crabs, either through leading blocks, or direct, according to circumstances.

To Dismount the Gun.

Strength of Detachment, 36 Nos.

Stores required.

Blocks, Bothway, 18-inch treble, with Yeatman's fittings (breech)	2
Blocks, single or snatch, 12-inch	2
" " " 18-inch	1
" 12-inch treble, with Yeatman's fittings (muzzle)	4
Crabs, iron, double purchase, 2-tons	3
Dragropes, heavy	4
Gaskets, white rope, 6-inch	1
" " 4-inch	2
Hammers, claw	1
Lashings, 2½-inch tarred, 5 fathoms each	8
Rope, hawserlaid, white, 6-inch, ¼ coil	1
" " " 4-inch, ½ coil	2
Scotches of sorts	12
Selvagees	4
Skids, fir, 6' x 12" x 12"	2
" oak, 3' x 9" x 6"	1
Slings, wire rope, muzzle, Yeatman's	1
Spanners, MacMahon	1

Mounting and Dismounting Guns (9-inch R.M.L.).**Section I.**

Remove sights, capsquares, and elevating arcs, and patches, traverse platform into centre of casemate, run gun back till the breeching loop is under the rear overhead bolt.

Elevate, attach breech and muzzle overhead tackles, and lead running ends of falls away to the iron crabs, double purchase, by which they are to be worked.

Heave in slack of muzzle tackles and hold on, heave round on breech tackle iron crab till the gun is high enough to admit of platform being traversed clear to a flank when carriage has been run up to front stops.

Then by walking back on all three iron crabs at once, the gun is lowered on to skidding placed on the floor of the casemate to receive it.

To Mount the Gun.

Is the exact converse of the foregoing.

Should at any time, in raising or lowering the gun, the trunnions get out of the horizontal, it is readily corrected by holding on with one muzzle tackle iron crab, while the other heaves round or walks back as required.

N.B.—If three iron crabs should not be procurable for working the Yeatman's tackles, or space to establish them all not be available, the breech tackle might still be employed with advantage in all operations where the gun is mounted with tackle at breech and jack at muzzle.

TO MOUNT OR DISMOUNT A 9-INCH R.M.L. GUN IN A CASE-MATE BY MEANS OF OVERHEAD TACKLES AT BREECH AND JACK AT THE MUZZLE.

Strength of Detachment, 19 Nos.*Stores required.*

Crabs, iron, double purchase, 2-tons	1
Chain, iron, short link, $\frac{1}{2}$ -inch, 4 fathoms ..	1
Dragropes, heavy	2
Gasket, 4-inch white rope	1
Hammer, claw	1
Handspikes, common, 7-foot	8
Jacks, lifting, hydraulic, 10 or 12-tons ..	1
Lashings, tarred, $2\frac{1}{2}$ -inch, 5 fathoms each ..	4
„ white or tarred, $1\frac{1}{2}$ -inch, 3 fathoms each ..	4
Levers, 14-foot	1
Luff tackles, complete	2
Planks, fir, whole, $10' \times 17'' \times 3''$..	4
„ oak, half, $6' \times 12'' \times 3''$..	2
„ „ $4' \times 12'' \times 3''$..	2
Roller, shifting, sabicu, $2' \times 5''$..	1
Ropes, parbuckle, $4\frac{1}{2}$ -inch tarred, 12 fathoms ..	1
Scotches, of sorts	20
Selvagees	4

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

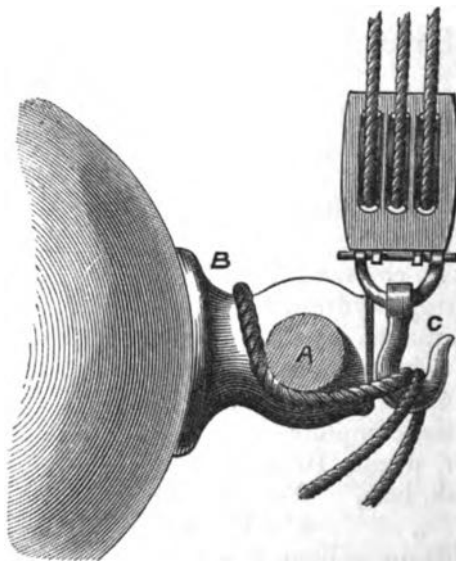
Slings, white rope, 6-inch, 12 feet long. .	..	1
Skids, fir, 20' x 9" x 9" .. ..	..	2
" " 6' x 12" x 12" .. ..	..	8
" " 4' x 12" x 12" .. ..	..	8
" oak, 3' x 9" x 6" .. ..	..	6
" " 3' x 6" x 6" .. ..	..	6
" " 3' x 6" x 3" .. ..	..	6
" " 3' x 4" x 4" .. ..	..	6
Tackles, 18-foot, light gyn, complete ..	..	1
Yarn, spun, lbs. .. ..	..	1

To Mount the Gun.

The platform is first brought into the casemate and placed on the rollers, the gun brought alongside (on a sleigh generally), and parbuckled on to the platform. This must be so effected that when the platform is traversed into the centre of the casemate, the breeching loop may lie under the rear overhead bolt. Trunnions are slewed, if necessary, to bring them horizontal with vent uppermost. A gyn tackle suspended from the centre overhead bolt, and with its lower block secured by a strap to one trunnion, affords a convenient method for slewing the trunnions.

The gun is now ready for raising.

Hook the treble block of the 18-foot light gyn tackle from which the running end comes off, to the rear overhead bolt, and lash the lower block close down to the cascable with a stout lashing or chain; should it be deemed advisable to get as much lift as possible, the lower block should be secured as follows:



A sabicu shifting roller, A, 5 inches in diameter and 2 feet long, is passed through the breeching loop. The tackle is overhauled till the hook of the lower block hangs in rear of the cascable at C.

Mounting and Dismounting Guns (9-inch R.M.L.).

Section I.

The centre of the lashing or chain* is placed over the neck of the cascable at B, the two ends are led under the roller, crossed over the hook at C, thence again under the roller and crossed over the neck of the cascable and, so on, until a sufficient number of turns have been taken, when the ends are made fast with a reef knot. By this, 8 or 9 inches more lift is gained than when the hook of the block is lashed to the cascable in the usual manner.

The method of raising and lowering the gun is precisely similar to that described at page 547, when mounting a 9-inch gun on a traversing platform in an open battery with one light 18-foot gyn at the breech and jack at the muzzle, only in this case the breech tackle is worked by an iron crab, double purchase, secured in any convenient position.

When the gun is high enough, the carriage is mounted up the rear and the gun lowered into trunnion holes.

To Dismount the Gun

Is the converse of the foregoing, and calls for no special remark.

ANOTHER METHOD.

The following method has in some casemates been found to answer very well.

Strength of Detachment, 19 Nos.

Stores required.

Same as in preceding case with the additional

Heavy gun tackles, complete	..	..	..	3
Sling or strap, chain, iron, short link, $\frac{3}{4}$ -inch,				
12 fathoms	..	..	..	1

N.B.—The parbuckle rope and fir skids 20' \times 9" \times 9" are not required.

To Mount the Gun.

The platform upside down is first run on rollers into the casemate, turned over with an 18-foot light gyn tackle suspended from the centre overhead bolt, lowered on to the racers, and traversed to a flank. The carriage is then brought into the casemate on rollers, and placed with its breast under the middle overhead bolt, and its rear under the rear bolt.

To Mount the Carriage.

The treble block of a heavy gun tackle is hooked to the middle overhead bolt, and the tackle overhauled till the lower block comes down to the buffer flange in the middle of the front of the carriage, to which it is lashed with a short piece of chain.

* A heavy dragrope or a short linked $\frac{3}{4}$ -inch iron chain about 3 or 4 fathoms long answer well. The chain has the advantage of not stretching.

Section I

Mounting and Dismounting Guns (9-inch R.M.L.).

The treble blocks of two heavy gun tackles are hooked into the rear overhead bolt, and the tackles overhauled until the lower blocks can be hooked into the two rear eyebolts of the carriage. Clip plates are removed, all three tackles manned, the carriage raised straight up till high enough, when the platform is traversed under it, the carriage lowered into position and the clip plates replaced. In lowering the carriage, it may have to be swung a little to the front, to enable the flange to go clear of the end of the piston rod of the buffer.

The platform is again traversed to a flank, the gun brought into the casemate on a sleigh and raised as in preceding case, till the breech tackle is "chock-a-block." The muzzle is lashed up to the front overhead bolt, with as many returns of the $\frac{1}{4}$ -inch chain strap as will go through the bolt (the returns of the chain passing under the chase), and the ends made fast with a reef knot. The carriage is run up to the stops; platform traversed under the gun; carriage run back till trunnion holes are under the trunnions; the breech tackle eased off from crab till the trunnions bear in the trunnion holes, and chain cast off.

In *some* casemates it would not be necessary to go on raising the gun till the breech tackle was "chock-a-block," but it must be raised sufficiently high to allow the platform and carriage to be traversed under it. The necessary height may be determined by measuring.

It has sometimes been found, after bringing a gun into the centre of a casemate on a permanent sleigh, that the most convenient way of raising it to the required height was to jack up the sleigh with the gun on it, using two jacks under the ends of the sleigh front and rear alternately, following up with crossbuilt skidding till high enough; then to chain up the chase to the front overhead bolt, raise the breech with a tackle as before, and run the sleigh clear. The gun, if not absolutely truly placed under the bolts, will swing gently into a plumb line as the weight is taken.

TO MOUNT OR DISMOUNT A 9-INCH R.M.L. GUN OF 12 TONS IN A CASEMATE BY JACKS ALONE.

This operation has to be resorted to in casemates which are either unprovided with overhead bolts or are fitted with bolts intended for a lighter nature of gun, such as the 68-pr. S.B.

Strength of Detachment, 19 Nos.

Stores required.

Dragropes, heavy	..	..	..	..	4
Handspikes, common, 7-foot	..	..	..	..	8
Jacks, lifting, hydraulic, 10 or 12-tons..	..	..	..	..	1
Do. do. Haley's screw, with traversing gear 16-tons	..	..	..	..	2

Mounting and Dismounting Guns (9-inch R.M.L.).

Section I.

Levers, 14-foot	2
Luff tackles, complete	2
Oil, in can	1
Planks, fir, whole, 10' x 17'' x 3''	6
Do. oak, half, 6' x 12'' x 3''	6
Do. do. do. 4' x 12'' x 3''	6
Rollers, ground, elm, 6' x 6''	3
Scotches, of sorts.	20
Selvagees.	4
Skids, fir, 14' x 8'' x 8''	4
„ „ 6' x 12'' x 12''	10
„ „ 4' x 12'' x 12''	10
„ oak, 10' x 13'' x 8''	1
„ „ 3' x 9'' x 6''	8
„ „ 3' x 6'' x 6''	8
„ „ 3' x 6'' x 3''	8
„ „ 3' x 4'' x 4''	8

To Mount the Gun.

Two methods of carrying out this operation present themselves: the first is to bring the gun into a convenient position in the casemate, the axis of the gun being coincident with a radius of the circle described from the pivot, trunnions horizontal, vent uppermost, and muzzle about 18 inches from the shield, and jack it up, breech and muzzle alternately, until nearly high enough; then raise the muzzle with jack and replace the muzzle skidding with two 14' x 8'' x 8'' fir skids, with an oak plank 6' x 12'' x 3'' on top, arranged under the short coil,* and supported on cross built skidding under their ends, 7 feet clear being left between the supporting piles of skidding. Lash an oak beam 10' x 13'' x 8'' on its edge with a stout chain or a couple of heavy dragropes to the cable, and place a screw jack on traversing bed under each end of the beam, the jacks being supported on cross built skidding, leaving a clear gangway of 7 feet between the supporting piles of skidding. If no screw jacks are procurable, hydraulic jacks must be used.

Run platform (with carriage mounted on it) back to rear stops, on 6' x 6'' rollers, straight from rear to front under the gun and lower on to racers. Run carriage up till trunnion holes are under trunnions. Traverse breech of gun with screw traversing arrangement of jacks, to right or left as necessary, and lower with the screw jacks into trunnion holes. If necessary the trunnions may first be received on oak skids in each trunnion hole, and the supporting skidding under the screw jack and short coil lowered, when the operation is continued as before and completed.

The advantages of employing screw instead of hydraulic jacks for lowering the breech are—1st. The fact of being able to

* The safest plan to effect this is to have cross built muzzle skidding under the chase near the half-weight mark, and to leave it there as a check, until the cross skids under the short coil have been placed.

Section I. Mounting and Dismounting Guns (9-inch R.M.L.).

traverse the suspended weight to either flank, and thus correct the position of the gun with reference to the carriage. 2nd. The lowering being thoroughly under control, the beam can be always kept horizontal, whereas it is difficult to lower off both ends of the beam with hydraulic jacks at the same rate, and unless great care be taken the gun may be upset and cause an accident.

To Dismount the Gun

Is the converse of the foregoing.

2ND METHOD.

Strength of Detachment, 19 Nos.

Stores required.

Much the same as before, but somewhat less skidding is required, as the following description will show.

To Mount the Gun.

Mount the platform on the racers, then, having brought the gun into the casemate, parbuckle on to centre of platform, with the trunnions sufficiently far to the front to admit of the trunnion holes of the carriage being brought under them when the gun is raised and the carriage in position on the platform. The muzzle about 18 inches inside the shield is generally found to be a convenient distance. Slew trunnions if necessary, the vent being uppermost, and lash beam across cascable as before. The gun is jacked up, breech and muzzle alternately, by jacks under the ends of the beam across the cascable, and by a jack applied at the muzzle, being skidded in rear, well back on the breech coil, and, in front, by cross built skidding placed on and across the platform about the half weight mark. When high enough, mount carriage up rear, clear away breech skidding, run carriage under gun and lower into trunnion holes as before, with screw jacks, if procurable, for the reasons before stated.*

The screw jacks may be substituted in place of the hydraulic jacks under the beam when the gun is nearly high enough.

To Dismount the Gun

Is the converse of the foregoing.

This last method is to be preferred, as requiring less skidding and affording greater stability, the platform being throughout underneath the gun, and when heavy weights are skidded up to a considerable height without anything under them, as is the case in the 1st method, a certain amount of insecurity results, as for instance if the skidding be struck in running the platform and carriage under the gun. It is also preferable for changing a carriage, or carriage and platform, from under a gun, in which case the muzzle support could be advantageously placed on the portsill.

In some casemates where the space is very limited, it is difficult to find room to place the platform and carriage square in rear of

Mounting and Dismounting Guns (10-inch R.M.L.).**Section I.**

the gun for running under the gun when raised, which is an additional argument in favour of the second method.

10-INCH R.M.L. GUN OF 18 TONS.**IN OPEN BATTERIES.**

In open batteries this nature of gun may be met with mounted in positions and on platforms similar to those described for the 9-inch, p. 546.

They are always mounted or dismounted with one gyn and jack or two gyns.

The following cases occur:—

1st. To remove carriage, or carriage and platform, from under the gun, or the converse.

Proceed as with 9-inch, page 547, using, however, an 18-foot heavy gyn at the breech, the gun being run up and skidded on the port sill or work.

2nd. To mount or dismount the gun (for removal) with gyn at breech and jack at muzzle.

Proceed as with 9-inch, page 547, using either an 18-foot heavy or light gyn to raise the breech, if the latter, skid gun well back on short coil.

3rd. To mount or dismount the gun with two gyns.

Proceed as with 9-inch, page 551, using however two 18-foot heavy instead of two 18-foot light gyns, or one 18-foot heavy and one 18-foot light gyn, provided the latter can be placed sufficiently near the muzzle.

IN "C" EMPLACEMENTS.*To Remove the Carriage from under the Gun.*

When a 10-inch gun is mounted in a "C" emplacement, and it is required to remove the carriage from under it, or to change it, it is most easily effected by skidding up under the gun, when elevated, well back under the short coil, the skidding being cross built on and across the platform; the breech is then raised with an 18-foot light gyn, and the trunnions received on a 6-inch piece in each trunnion hole, on which the gun is pivoted, the gyn tackle being overhauled, the skidding under the short coil raised, and another lift taken with the gyn. This should clear the gun from the carriage sufficiently to enable the latter to be dismounted down the rear.

Any required number of lifts may be taken in like manner by receiving the trunnions on oak skidding and pivoting the gun on them, &c.

Strength of detachments will vary with the nature of gyn employed.

The stores detailed for the 9-inch will be found to be a fair approximation of what is required. Should further information on this subject be needed [see list of stores, page 613].

Section I. Mounting and Dismounting Guns (10-inch R.M.L.).

To Remove Carriage and Platform.

In this case the gun is run up to the front stops, elevated, and skidded up under the chase. The skidding will probably have to be cross built from the bottom of the sunken way of the emplacement, though it may be possible to get a bearing for the chase by skidding on the parapet in front. The gun is then raised with an 18-foot heavy gyn at the cascable, proceeding as in the preceding case, and when high enough carriage and platform are removed to the rear.

To mount or dismount the gun proceed as with 9-inch in "C" emplacement, page 552, when using gyn at breech and jack at muzzle.

IN CASEMATES.

The operations of mounting and dismounting guns of this nature in casemates are so similar to those fully described for 9-inch, page 555, and following, as to need only the following remarks:—

In raising the breech with an ordinary service tackle use an 18-foot heavy gyn tackle, except when proceeding in the manner described for 9-inch, page 557, when an 18-foot light gyn tackle would suffice to raise the breech of an 18-ton gun if skidded in front on and across the platform well back on the short coil.

In mounting or dismounting with jacks alone, the dimensions of the oak beam for lashing to the cascable should be 10' x 15" x 9".

In this operation the 2nd method, page 562, is to be preferred for the reasons there stated, which apply with still greater force with the 18 than with the 12-ton gun.

If three iron crabs should not be procurable for working the "Yeatman" tackles, or space to establish them all not be available, the Yeatman breech tackle might still be employed with advantage in all operations where the gun is mounted with tackle at breech and jack at muzzle.

MOUNTING AND DISMOUNTING 18-TON GUNS ON SMALL PORT CARRIAGES.

When guns are mounted on small port carriages, the height of the casemates does not allow of the gun being raised high enough by overhead gear to run the platform and carriage under it. This must then be done by jacks, breech and muzzle being raised alternately, and the gun lashed by chains (the slack of which is taken in by tackles as the gun rises) to the overhead loop bolts. When high enough the platform is run under the gun, the breech jack supported on the platform, and the operation of raising continued till the trunnions will clear the cheeks of the carriage; the chains are then secured, jacks removed, carriage mounted on the rear of the platform

Mounting and Dismounting Guns (11 & 12-inch R.M.L.).**Section I.**

and run under the gun. The trunnion blocks are then elevated by the screws till the trunnions resting in them, the chains can be removed. If necessary, the gun can be lowered on to the trunnion blocks by jack at the breech. The hydraulic gear is then adjusted. The trunnion blocks should be fitted to the carriage, and the screw gear fixed under the gun before lowering the gun on to the carriage, more room being afforded then than after the carriage takes the weight.

11-INCH AND 12-INCH R.M.L. GUNS OF 25 TONS.**IN OPEN BATTERIES.**

In open batteries these natures of guns may be met with mounted in positions and on platforms similar to those described for the 9-inch, page 546.

They are always mounted or dismounted with one gyn and jack or two gyns.

The following cases occur:—

1st. To remove the carriage, or carriage and platform, from under the gun or the converse.

Proceed as with 9-inch, page 547, using, however, an 18-foot heavy instead of an 18-foot light gyn at the breech, the gun being run up and skidded not further forward than the half weight mark; to effect this, if the bearing on the port sill or work comes too far forward, and both carriage and platform have to be removed, cross-built skidding must be built up from the ground; or an oak beam $11\frac{1}{2} \times 20'' \times 10''$ on its flat with two oak planks $6' \times 12'' \times 3''$ on top placed under the gun, when elevated, at the half weight mark or short coil, the ends being supported by cross-built skidding, with a clear gangway of 8 feet between the supporting piles of skidding.

Should it, however, only be required to remove the carriage, it would be found most convenient to skid up in front under the gun when elevated, with cross-built skidding, placed on and across the platform under the short coil, and proceed as with 9-inch, page 553.

2nd. To mount or dismount the gun with gyn at breech and jack at muzzle.

Proceed as with 9-inch, page 547, using, however, an 18-foot heavy instead of an 18-foot light gyn to raise the breech, and skidding up in front under short coil or half weight mark.

3rd. To mount or dismount the gun with two gyns.

Proceed as with 9-inch, page 551, using, however, two 18-foot heavy instead of two 18-foot light gyns.

IN "C" EMPLACEMENTS.*To Remove Carriage from under Gun or the Converse.*

Proceed as with 10-inch, page 562, using, however, an 18-foot heavy gyn to raise the breech.

Section I. **Mounting and Dismounting Guns (11 & 12-inch R.M.L.).**

To Remove Carriage and Platform.

Strength of Detachment, 19 Nos.

Stores required.

Drag-ropes, heavy	..	..	..	..	4
Gyns, 18-foot, heavy, with stores complete	..	..	..	..	1
Handspikes, common, 7-foot	..	..	..	..	8
Jacks, lifting, hydraulic, 10—12-tons	..	..	..	..	1
Planks, fir, whole, 10' x 17" x 3"	..	..	..	..	8
„ oak, half, 6' x 12" x 3"	..	..	..	..	6
„ „ „ 4' x 12" x 3"	..	..	..	..	6
Skids, fir, 6' x 12" x 12"	..	..	..	..	12
„ „ 4' x 12" x 12"	..	..	..	..	24
„ oak, 3' x 9" x 6"	..	..	..	..	12
„ „ 3' x 6" x 6"	..	..	..	..	8
„ „ 3' x 6" x 3"	..	..	..	..	8
„ „ 3' x 4" x 4"	..	..	..	..	6

The following method will usually be found the most convenient:—

Traverse platform into centre of emplacement and place 18-foot heavy gyn over it, the gyn being as far to the front as possible; the foot of the prypole will probably have to be supported by skidding over the sunken way. Run the gun up or back, so as to bring the neck of the cascable under head of gyn.

Elevate gun, and cross build skidding from bottom of sunken way under chase, not further forward than half weight mark, raise gun clear of carriage as already described, page 553, and remove carriage and platform to the rear (page 598) where instructions are given regarding the removal of these heavy platforms, and an idea of the requisite stores for that purpose afforded.

TO MOUNT OR DISMOUNT A 25-TON GUN ON TRAVERSING PLATFORM IN "C" EMPLACEMENT WITH 18-FOOT HEAVY GYN AT BREECH AND JACK AT MUZZLE.

As with 9-inch, page 552, an 18-foot heavy gyn at breech is, however, necessary.

IN CASEMATES.

The operations of mounting and dismounting guns of these natures in casemates are so similar to those described for 9-inch, page 555, and following, as to need only the following remarks.

In most casemates it will be found when mounting or dismounting a 25-ton gun with the Yeatman tackles, that from the

Mounting and Dismounting 35 and 38-ton Guns.**Section I.**

very forward position of the front bolt, the breech tackle will have to lift close on 15 tons, therefore a good, sound, 6-inch fall should be used.

When raising the weight, it is necessary in order to enable an ordinary service 2-ton iron crab to give sufficient power, to apply a "runner" tackle to the running end of the Yeatman breech tackle, which "runner" generally consists of one single 12-inch Bothway block, giving a power of 2 to 1. If three iron crabs should not be procurable, or space to establish them all not be available, the Yeatman breech tackle might still be employed with advantage in all operations where the gun is mounted with tackle at breech and jack at muzzle, indeed, with a 25-ton gun no lighter tackle than two treble 18-inch blocks should be used in casemates for the breech,* and the great length of the service Bothway blocks of this nature precludes their employment.

With these guns therefore the different modes of mounting and dismounting in casemates may be said, as a rule, to be confined to the following, viz. :—

1st. With the Yeatman tackles.

2nd. With Yeatman breech tackle and jack at muzzle, rest of operations as with 9-inch, as described at pages 557 and following.†

3rd. The method described for 9-inch at page 557, using, however, an 18-foot heavy gyn tackle to raise the breech if no Yeatman tackle for breech be procurable, and skidding up in front on and across the platform not farther forward than the half weight mark.

4th. By jacks alone, in which the dimensions of the oak beam for lashing to the cascable should be $11\frac{1}{2}' \times 20' \times 10''$, otherwise the operation is the same as with 9-inch, 2nd method, page 562; this is to be preferred to the first method, for the reasons stated, which apply with still greater force with 25-ton guns than with smaller natures.

35 AND 38-TON GUNS.**MOUNTING AND DISMOUNTING IN OPEN BATTERIES.**

The simplest and safest way of effecting this is by employing one 18-foot heavy gyn to raise the breech, and a screw or hydraulic jack to raise the muzzle.

* If it is intended to chain up the muzzle to the front bolt on account of its forward position.

† This has reference both to the case where the gun is raised with tackle at breech and jack at muzzle, the muzzle chained up, and platform and carriage traversed under the gun, and also to the case in which the gun is first parbuckled on to the platform, raised with tackle and jack, and carriage mounted up the rear.

Section I. Mounting and Dismounting 35 and 38-ton Guns.

The gun is first parbuckled on to receiving skids on its platform, which latter may be skidded horizontally during the operation.

Care must be taken that the trunnions of the gun are in such a position that the trunnion holes of the carriage can be run under them when the gun is suspended.

As a rule, the most convenient position will be as far to the front as possible, so that the carriage may be partially on the platform before the gun is raised.

The main points to be observed are—never to get the axis of the gun much out of the horizontal, to avoid a lurch, and pay the *utmost* attention to building up the skidding, so as to insure perfect stability.

The trunnions must be slewed by means of the gyn or otherwise, should the vent not be uppermost.

Should the gun require to be further raised, first jack up the muzzle until the gun is slightly elevated, and skid up to that on the short coil close in front of where the breast of the carriage will be when run up under the gun.

Run down the jack, scotch up, and, if the skidding is not very stable, lash back the uppermost supporting skid, to prevent the gun lurching to the front when raising the breech.

Then raise the breech with the gyn until the gun is slightly depressed, skid up under the breech coil, lower with the gyn levers on to skidding, and scotch up.

Raise the muzzle as before, then the breech, until the gun is high enough for the carriage to be run under it. Clear away breech skidding, and run carriage up.

The gun is then lowered into the trunnion holes.

If the muzzle skidding be placed well back on the short coil, the lift at the breech will not exceed what the gyn can safely take.

The lift for the jack need not exceed about 10 tons.

Dismounting in open batteries is the converse of the above.

MOUNTING AND DISMOUNTING THE GUNS IN "C" EMPLACEMENTS.

In this case it may be found most convenient to parbuckle the gun on the platform from the direction of the ramp, and afterwards to traverse gun and platform, fore and aft, or into the centre of the emplacement, before placing the gyn over the cascable preparatory to raising; and the converse in dismounting; but should it only be intended to remove the carriage (or the carriage and platform) from under the gun, it will probably be found most convenient to traverse into the centre, and run the gun up to the front stops before raising out of the trunnion holes; for, with the muzzle over the parapet, but little skidding is required for the muzzle jack to stand on.

Mounting and Dismounting 35 and 38-ton Guns.

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MOUNTING AND DISMOUNTING IN CASEMATES.

The method of mounting and dismounting these guns, introduced by Colonel Inglis, R.E., by means of a wrought-iron box-beam and special gear, should be employed at those stations to which the apparatus has been issued, as it is undoubtedly the best and safest. It will be hereafter described; suffice it here to observe that, as it not only requires the special gear, but also specially fitted overhead bolts, many instances will probably occur in which other means will have to be resorted to, and these may be divided into three heads, viz. :—

1. By overhead tackles alone.
2. By overhead tackles and jacks.
3. By jacks alone.

BY OVERHEAD TACKLES.

As regards the first, but little need be said, for it is hardly probable that in any instance will the height of the casemate be sufficient to admit of its being carried out. Should, however, such a case occur, the gun should first be parbuckled on to the platform, and muzzle and breech raised alternately, followed up with skidding, until sufficient height is gained. Then, on the breech skidding being cleared away, the gun is left suspended by the breech tackle, and supported in front by skidding under the short coil. The carriage is then run up, and the gun lowered in the usual way into the trunnion holes.

Throughout the operation care must be taken not to give either breech or muzzle tackle a greater lift than its safe working strain admits of.

BY OVERHEAD TACKLES AND JACKS.

A combination of these two affords a safe and easy way of either mounting or dismounting, and can be worked out whenever the rear overhead bolt is high enough to allow sufficient lift being obtained at the breech, before the tackle is chock-a-block.

It is precisely the same operation as mounting in the open with heavy gyn and jacks, previously described, only the fall of the breech tackle is taken in by a winch, instead of by the gyn windlass.

BY JACKS ALONE.

This is always a delicate operation, requiring much care. The gun having been parbuckled on to its platform, is jacked up breech and muzzle alternately (carefully following up with skidding), until very nearly sufficient height is obtained; when a cross-beam at the cascable is going to be used as the means of suspending the breech, a suitable special oak baulk—*e.g.*, 11½' × 10" × 20"

(A. M.)

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Section I. Mounting and Dismounting 35 and 38-ton Guns.

deep—should be selected, capable of safely supporting a load of about 15 tons, with an interval of 7 feet between the points of support; and the centre of this beam is securely lashed or chained to the cascable.

The muzzle skidding should be placed about the centre of the short coil, and may be lashed back to the rear eye-bolts of the platform for extra security.

For the last inch or two of lift, it will be safer to use screw-jacks under the beam, because they stand on a much more broad and stable base than ordinary hydraulic jacks. They admit of the breech being slightly traversed to right or left, which is often necessary in lowering, to enable the shoulders of the trunnions to clear the inner surfaces of the trunnion holes; and, what is most important, they are so thoroughly under command in lowering that no difficulty is experienced in keeping the beam perfectly horizontal, whereas, with hydraulic jacks, in even the most skilful hands, it is nearly impossible to guard against one being run down faster than the other, and the result is that the beam becomes inclined, and the gun will very likely lurch to the lower flank. The carriage is run under, and the gun lowered in the usual way.

When screw-jacks are not available, the safest plan is to dispense with the cross-beam at the breech, and proceed in the following manner:—

The gun being jacked up to the required height and skidded, as before, the breech is securely lashed or chained up to the rear-overhead bolt, the breech skids cleared away, and the carriage run under.

The breech is now slightly raised with a jack, skidded up between the brackets of the carriage, and the chain or lashing at the cascable cast off. The gun is then lowered by jacks, breech and muzzle alternately, into the trunnion holes. If the construction of the carriage will not admit of the gun being skidded up between the brackets, or of a jack being applied under the cascable, the beam must be used, and oak skidding used under the trunnions.

The ring and shackle issued for the cascable of the 35 and 38-ton guns afford a ready means of lashing up the breech.

No hard-and-fast rule can be laid down as to the best manner of bringing these heavy guns into the casemate and getting them alongside their platforms; but in most cases it will probably be found most convenient to move the gun on sleigh and rollers.

MOUNTING AND DISMOUNTING BY MEANS OF THE "BOX-BEAM."

The apparatus consists of the following parts, viz.:—

One box-beam, 10 feet 4 inches long, $7\frac{1}{2}$ inches to 10 inches deep, and 18 inches wide, curved in the centre part, and weighing $17\frac{1}{2}$ cwt.

Mounting and Dismounting 35 and 38-ton Guns.

Section I.

Two main screws, 3 inches in diameter and 5 feet long, to pass through holes near the end of the box-beam, and provided with nuts for suspending the beam to overhead bolts built permanently into the roof of the casemate.

Two loop bolts, 2 inches in diameter and 3 feet long, for suspending the gun to the box-beam.

Two studs screwed into the trunnions of the gun, and fitting the loop bolts.

Total weight, including beam, 1 ton 6 cwt. 1 qr.

Method of using the Apparatus.

Bring the gun into the casemate, and place it on its sleigh or skidding, with its trunnions under the overhead bolts in the roof.

Hoist the box-beam with tackles from the roof, and place it on the gun over the trunnions; a lever lashed to its centre, and manned by three or four men, serves to keep it steady during the operation.

By hooking a single 8-inch block to the overhead bolts, and making fast the fall slightly above their centres of gravity, the main screws, having been passed up through the beam, may be hoisted to the required height and nuted (with lock-nut also) to overhead bolts, and on under side of beam. Pass the loop bolts under the trunnion studs, already screwed into the gun, and nut them to the box-beam; a plate of iron being interposed between the nuts and the upper surface of the beam.

The loop bolts are tightened up ready for lifting the gun.

A 30-ton jack is now applied under each end of the beam and worked up, the preponderance of the gun being counteracted, if necessary, by a shot placed in the muzzle.

During the operation of raising the gun, the trunnions should be kept horizontal and the beam be closely followed up with the spherical nuts on its underside.

If, at starting, the trunnions be not exactly true with the overhead bolts, ease off the jacks, and the gun should adjust itself.

The beam is thus raised as high as the roof will allow, when jacks and skidding are cleared away, and the gun left suspended.

The carriage having been placed fairly under the gun, which will generally have to be done from the front, is hoisted till the trunnion holes are in contact with the trunnions; this may be effected as follows:—

The front of the carriage is raised by means of two 16-foot light gyn tackles, the treble block of each tackle being chained up to the box-beam, and the double block hooked into a front eye-bolt of the carriage; the falls may be taken in, either by crabs, or by luff tackle runners made fast to their running ends.

The rear of the carriage is raised with levers, what is got at each lift being kept by two luff tackles taking in the slack of a 4½-inch rope, arranged to pass over the neck of the cascable and under the rear transom of the carriage, as shown in Fig. 1.

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Section I. Mounting and Dismounting 35 and 38-ton Guns.

When the carriage is high enough, the falls of the tackles are made fast, and the platform, which should previously have been mounted on the racers on the other side of the casemate, is traversed underneath; the tackles being now eased off, the carriage is lowered into position on the platform.

The gun is lowered into the trunnion holes by means of the jacks, great care being taken to keep the trunnions horizontal, and that the spherical nuts are at all times nearly in contact with under side of the beam.

The operation of dismounting is the exact converse of the foregoing.

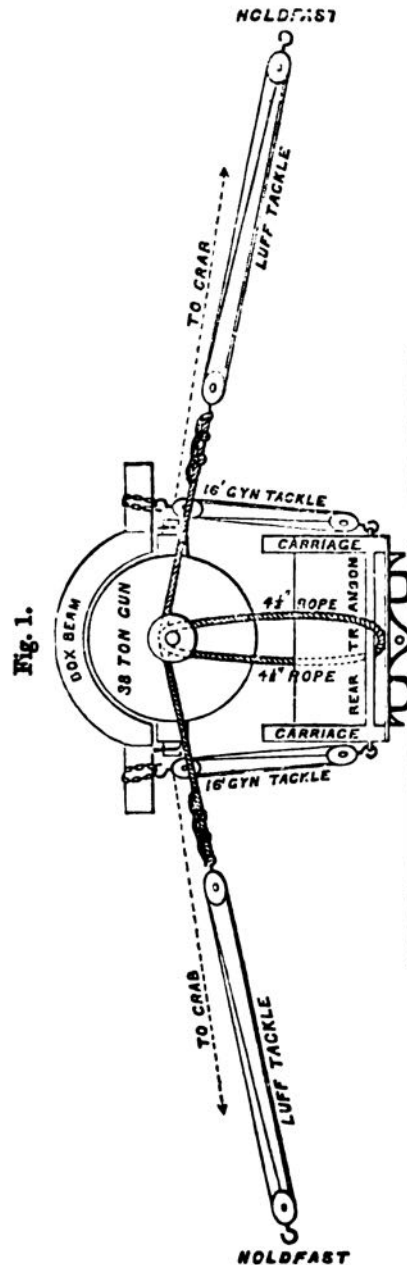
MOUNTING AND DISMOUNTING BY BOX BEAM
(SUSPENDED FROM ROOF OF CASEMATE).*Stores required.*

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Box-beam, complete	—	1	To support rear of carriage, with two luff tackles	Or one 4½-inch par-buckle rope.
Cordage, fathoms	4½-inch	6		
Handspikes, common	7-foot	6		
Jacks, lifting, hydraulic, Tange's, with portable base .. }	30-tons	2	—	These jacks are required with 38-ton gun.
Lever, wood	14-feet	2		
	12 "	2		
	8 "	1		
Planks, wood, oak, moving guns	10' x 12" x 3"	4		
	6' x 12" x 3"	4		
Ropes, drag, heavy	—	6		
Scotches, wood .. { large ..	1' x 6" x 6"	6		
	medium ..	6		
	small ..	6		
Selvagees.. ..	—	4		
Skids, wood { Fir ..	6' x 12" x 12"	8		
	4' x 12" x 12"	8		
	Oak ..	12		
Tackles { Gyn, 16-ft., complete ..	3½-inch rope, 15 fathoms	2	For raising front of carriage.	
	Luff, tarred rope, viz., 1 double and 1 single 8 inch Admiralty block	4		

N.B.—Short lengths of ½-inch chain (about 4 fathoms each) will be found useful when hoisting the carriage by tackle made fast to the box-beam.

Mounting and Dismounting 35 and 38-ton Guns.

Section I.



Raising the carriage of 38-ton gun up to the gun when suspended by box-beam from roof of casemate.

Section I. Mounting and Dismounting 35 and 38-ton Guns.

BOX-BEAM SUSPENDED FROM FRAME.

In casemated works, where the height to crown of arch is 12 feet, or in open works, when it is intended to make use of the box-beam for mounting or dismounting 35 and 38-ton guns, a frame of teak and iron is erected, from which the beam is suspended, instead of from the roof, as in the previously described case. The frame may be briefly described as consisting of two pairs of teak posts or uprights, about 9 feet 6 inches in length, and 10 inches by 10 inches in section, their feet standing in wrought-iron bases, and their heads fitted with wrought-iron caps. Stability is ensured by means of two cross-beams, also of teak, 10 inches by 10 inches in section, which are bolted into the wrought-iron caps at the head of the uprights, and further secured by diagonal stays.

When in position, there is a height in the clear under the cross-beams of 9 feet 9 inches, and a clear interval between the uprights of 8 feet 7 inches.

The entire weight of the gun and beam is taken by the wrought-iron caps on the heads of the teak posts, the cross-beams being only used to steady and brace the uprights.

Method of using the Apparatus.

Each pair of posts may be fitted to their bases and caps in any convenient spot, and brought on rollers to the place where the gun is to be mounted. They may either be put together on the floor and afterwards be up-ended, or they may be erected at once in a standing position, as may be deemed most convenient.

In putting the frame together the following points should be observed:—

The two pairs of posts to be set exactly opposite to each other, with their bases on the same level, and at the distance of 8 feet 7 inches apart, measuring from post to post. The bases to be laid quite horizontal, and the posts to be set plumb.

If these directions be observed, there will be no difficulty in setting the cross beams in position, bolting them to the caps, and fixing the diagonal braces.

When the gun which is to be mounted has been brought into position, the framework should be accurately levelled and so adjusted that it shall be exactly square with the axis of the gun, the gun being midway between the posts, and its trunnion axis central in the frame.

The rest of the process of mounting is the same as with the box-beam slung to the roof, except that in an ordinary casemate the gun will be mounted in a central position, and not at any degree of right or left training.

In using this frame, it will probably be most convenient to hoist the box-beam and hang it on the main screws, already natted

Mounting and Dismounting 35 and 38-ton Guns.

Section I.

and lock-nutted to the caps, before the gun is brought into position; or the frame with the box-beam suspended in it may be brought, by means of drag ropes attached to the posts and small iron rollers under the bases, to the gun if it be already in position.

If the lifting jacks are sufficiently powerful, their speed can be so adjusted that in raising or lowering the box-beam its ends can be kept level, and a scale on the outside of each pair of posts will facilitate this adjustment.

Holes have been provided in the wrought-iron caps and bases, so that if at any time it may be found desirable to move each pair of posts in one piece, coach screws may be inserted into the posts to secure them in their sockets.

The operation of dismounting is the reverse of that of mounting a gun.

GEAR FOR MOUNTING AND DISMOUNTING HEAVY ORDNANCE IN LOW-ROOFED CASEMATES LESS THAN 9 FEET 6 INCHES IN HEIGHT.

Stores required.

	No.
Screws, 3-inch, with spherical nuts	3
Shackles, 4-inch, washer-plate and bent-bolt ..	3
Jacks, lifting, hydraulic, Tangy's, with portable bases, 30-tons	2
Skidding for base of jacks, as required.	

Description.

In cases where the height from the floor of a casemate to the underside of the roof-beams is under 9 feet 6 inches, the box-beam apparatus cannot be used for 38-ton guns.

Two such cases occur in the curve-fronted casemates with turn-tables at Sliema Point Battery, Malta. The arrangement proposed for use there is shown in drawing I. G. of F., No. 31,168.

Three sets of overhead bolts, carrying 4-inch washer plates, have been built into the roof of each casemate in the position shown in the drawing, and they will remain as fixtures there. Two of these are laid out to be over the trunnions, and the other over the cascable of a 38-ton gun when run in about 5 feet 9 inches from the right hand port of the casemate at 10 degrees "trail right." From each of these is hung a 3-inch screw with a spherical nut on the top of the overhead washer, and on each

Section I.

Mounting and Dismounting Guns.

screw is hung a shackle consisting of a 4-inch washer plate and a bent bolt nutted to it. Two of these shackles fit the trunnion studs of the gun, the other its cascable. The 3-inch screws are for following up and taking the weight of the gun, but not for lifting it. The lifting power is in two hydraulic jacks in steadying frames, to be used as hereafter described.

Method of using the Apparatus.

Supposing the gun to have been brought into the casemate, and that it has been carefully adjusted so that its trunnion studs are under the overhead washers, the shackles should be put on the studs and the cascable, and the 3-inch screws passed through the overhead washers and the washers of the shackles, and nutted to them. Especial care should be taken to pin the upper nuts to the main screws as shown in the drawing. When this adjustment has been completed, and the gun is found to hang fairly with its trunnions level, the muzzle may be depressed until the cascable is raised a few inches (say about 4 inches), the lower nut on the cascable screw being screwed up and carrying the shackle with it as the cascable rises. Then place the timber beam shown in the drawing under the chase of the gun at its half-weight mark, and using two 20-ton jacks in steadying frames, as described at pp. 10-11, proceed to raise the gun. During this operation the lower nuts on the trunnion screws must be continuously worked up so that the bent bolts of the shackles shall be kept *close* to the underside of the trunnion studs. The adjustment of these nuts should be also regulated with the view of keeping the trunnions horizontal as the gun rises. When a convenient amount of lift has been obtained, the muzzle may be again depressed and the lifting operation repeated, until the gun is brought to the position shown in the drawing, or to the height found necessary for mounting it in its carriage.

If the gun be raised till it is close to the roof beams in the Sliema casemates, it is expected that there will be ample height to admit of the carriage being attached to the gun, and of the platform being traversed under them.

For lowering the gun into its carriage in the operation of mounting, or for lowering it to the floor of the battery in the operation of dismounting, the reverse of the process above described will be adopted, that is to say, the lower nut on the cascable screw will be worked downwards, and the muzzle elevated to some convenient height. The jacks under the chase will then lower the gun, and the lower nuts on the trunnion screws, having been previously released, will be worked downwards at such speed, corresponding with the speed of the jacks, as shall keep the bent bolts of the shackles all the time *close* under the trunnion studs. This operation may be repeated as often as may be necessary.

Mounting and Dismounting Guns.

Section I.

For the operation of lowering the gun, it may be found to be more convenient to place the jacks about 2 feet 6 inches from the muzzle, in order that they may be clear of the platform.

Care will be required to work the jacks so as to make the gun keep its normal direction while it is being raised or lowered, and also to keep its trunnion axis horizontal.

Although two 20-ton jacks have been specified in the above description, it is probable that the operations could be performed with one 30-ton jack, or with two of less power than the 20-ton jack.

HOISTING GEAR FOR LANDING GUNS AT SEA FORTS.

Figs. 2, 3.

The hoisting gear provided for landing and embarking 38-ton guns at sea forts consists of:—

1. A pair of parallel cantilever beams overhanging the water at the entrance.

2. A traveller, moveable along these beams by means of an endless racking chain, and carrying two pairs of pulleys for a hoisting chain. This hoisting chain passes from the interior of the fort between the beams, and is carried round a compensating pulley at their outer ends. Two bights hang from the pulleys of the traveller, and a pair of single pulleys, attached to the hook by which the gun is slung, are hung in these bights, as in a "foundry crane" (by adopting this "foundry crane" arrangement the gun may be run in and out without altering its level).

3. A capstan, worked by manual labour, standing on the roof of the fort, and capable of being connected either with the hoisting or the racking chains. This capstan takes in or pays out the hoisting chain, if the racking chain be held, thereby lifting or lowering the gun; or it pulls the racking chain in either direction, if the hoisting chain be held, thereby running the gun in or out.

4. A cantilever staging at the entrance to receive the gun on a sleigh and rollers.

The main beams are of wrought iron, and carry steel rails on their upper surfaces on which the traveller runs. They are connected together at their outer ends, and are secured at their inner ends by holding down bolts to the masonry of the fort. The clear overhang of these beams varies at the different forts from 18 to 21 feet from the support to the centre of the hook, from 13 to 15 feet of this being over the water, and the in-and-out movement of the traveller is 16 feet. The hoist is about 28 feet.

The traveller is formed of wrought iron, the wheels having steel tires, and the chain pulleys are suspended from the axles of the traveller wheels, so as to lie between the main beams.

Section I.

Mounting and Dismounting Guns.

The hoisting and racking chains are of $1\frac{3}{4}$ -inch short link crane chain, except in that part of the hoisting chain which passes through the capstan, where pitch chain is used.

The capstan is manned by 40 men; the diameter over the arms, of which there are ten, being 26 feet. The capstan head can either be run loose, or can be thrown in gear, by suitable clutches, with two chain wheels, over which the two ends of the hoisting chain pass, or with another, embraced by the racking chain.

The principal toothed wheels are of steel, the framing is of cast iron.

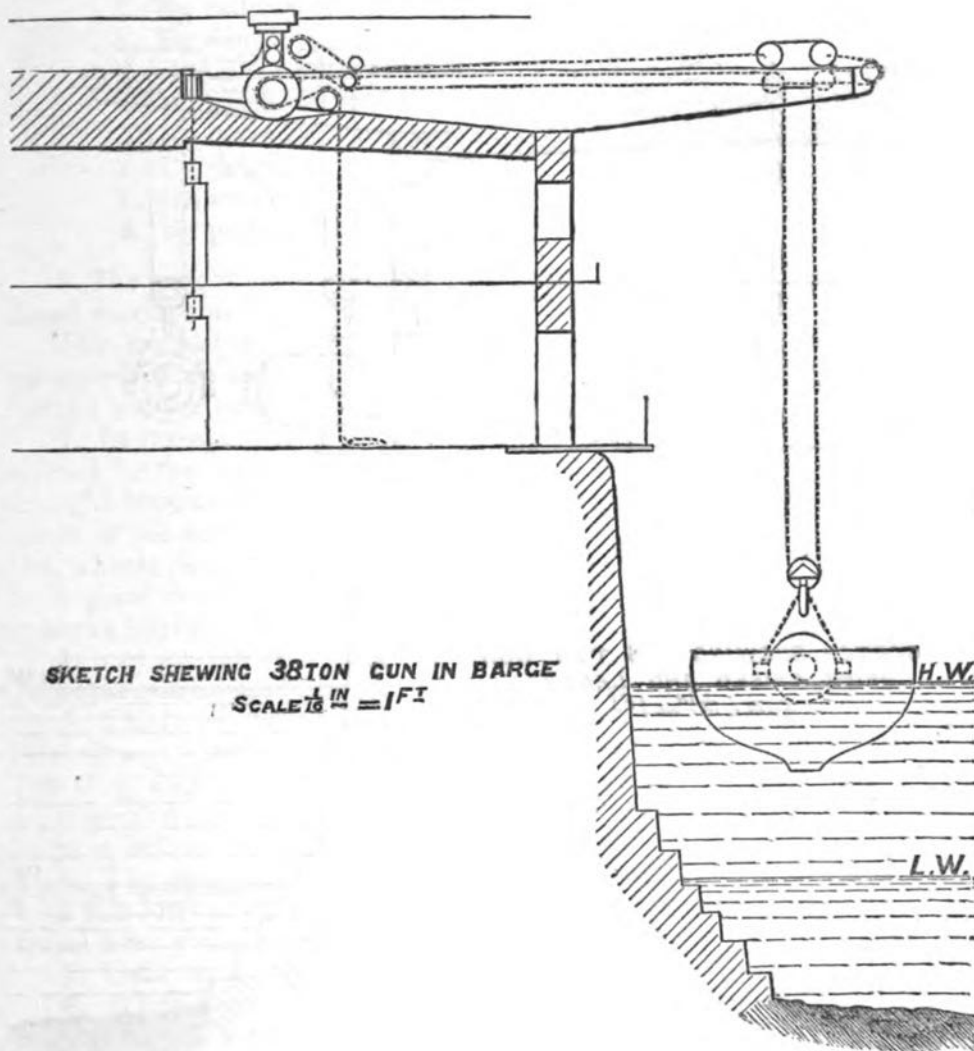
Provision against accidents to the hoisting gear is made by the use of a worm-wheel keyed on to one of the main shafts, and gearing into an endless screw, which is turned by a hand wheel. To allow the machinery to move, either for hoisting or lowering, this screw must be kept turning by an attendant at the same speed as that at which the worm-wheel into which it gears is turned by the working of the capstan.

A similar arrangement is applied to the racking gear, and serves to hold the racking chain when not in gear with the capstan. The slack ends of the hoisting chain pass by hawse pipes to the lower floor of the fort, and are coiled away as the hoisting proceeds.

Mounting and Dismounting Guns.

Section I.

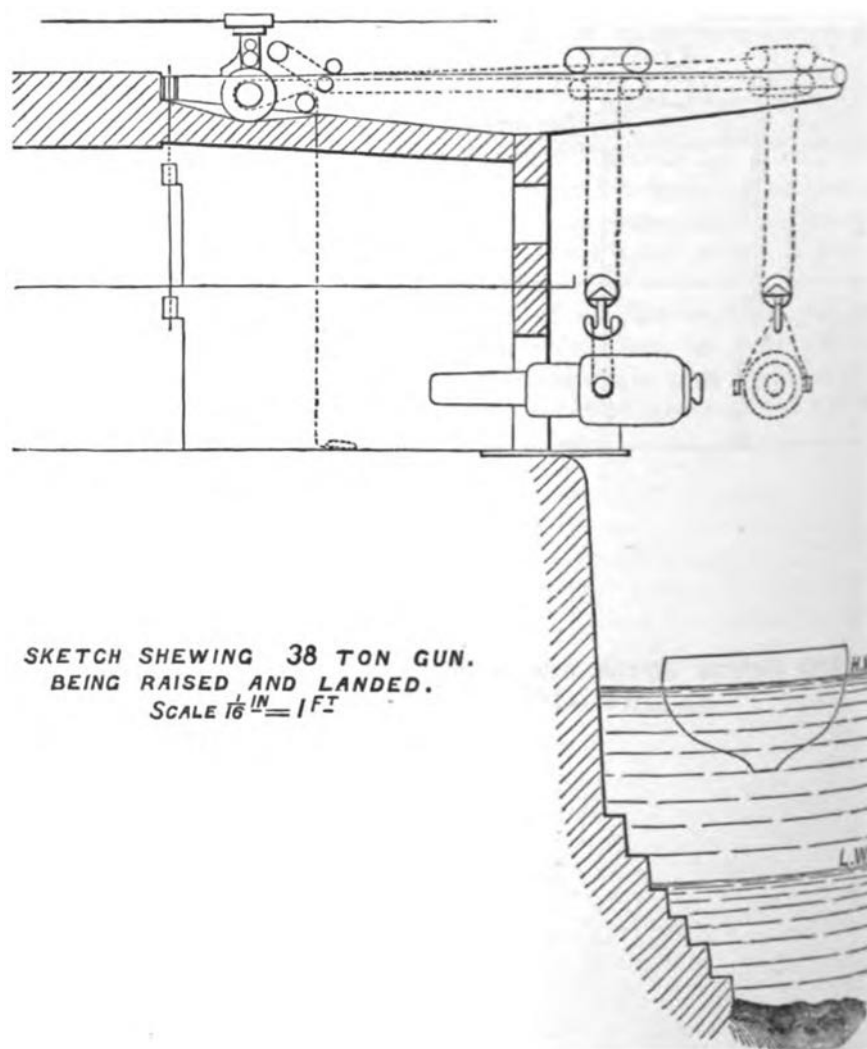
Fig. 2.



Section I.

Mounting and Dismounting Guns.

Fig. 3.



Moving Guns.

Section II.**Section II.—Moving Guns.****GENERAL OBSERVATIONS.**

The methods of transporting or moving guns on land are confined to the following :—

1. By railway trolley.
2. By drag.
3. By sling wagon and sling cart.
4. By platform wagon.
5. By travelling carriage.
6. By sleigh.
7. On rollers.
8. By parbuckling.

1. The weight for which a trolley is constructed will generally be found marked on it, and should not be exceeded.

This method of transport, for any but a short distance, naturally commends itself as being the most expeditious and easy, especially for the heavier natures, but it is not often available.

2. In transporting guns on drags, the main point to be considered is the state of the roads to be traversed; when bad, the draught becomes so heavy that no harness will stand the strain it becomes necessary to exert, and the result of placing planks under the wheels is generally that the planks are expended, and but little good done. The heavier the gun the more forcibly these remarks apply.

It may be accepted as a rule that 7 tons is about the heaviest load that can be drawn by horses over good roads in a level country.

3. The foregoing remarks apply also to transport by sling wagon or sling cart. When guns of 7 and 12 tons weight are slung from two sling wagons in the manner described at page 509, they may be drawn for short distances by manual labour, making use of large squads of men or of capstans for the purpose.

4. The platform wagon is only intended to carry 64 cwt., and with this load a team of 6 or 8 horses would probably be able to travel over any ordinary good road.

5. Calls for no special remarks.

6. When heavy guns are moved on sleighs, whether temporary or permanent, very large bearing surfaces may be obtained by keeping three or four rollers under the sleigh, so that with a properly constructed roadway of planks or skids, or a combination of the two, there is hardly any ground, level or sloping, over which a heavy gun may not be conveyed in this manner, though it is of course very slow compared with wheel transport.

7. On rollers; this is only applicable for moving over very short distances.

8. The same may be said of parbuckling.

Section II.

Moving Guns (64 and 80-Pr.).

Local circumstances, and the means available, can alone enable one to decide which of the foregoing methods it would be most advisable to adopt in any particular case.

N.B.—When wheel transport is employed, traction engines may sometimes be used with advantage to take the place of horse draught or manual labour.

Transporting axles may be used for 7-inch and 9-inch guns (without carriages) on their platforms in cases of emergency.

64-PR. R.M.L. GUN.

The 64-pr. R.M.L. gun may be transported by land by the following means:—

1. By railway trolley.
2. By 5-ton gun drag.
3. By sling wagon or sling cart.
4. By platform wagon.
5. By sleigh.
6. On rollers.
7. By parbuckling.
8. On a travelling carriage.

The gun may either be parbuckled up on to the trolley, or raised with a gyn and the trolley run under it.

The same remarks apply in placing the gun on a 5-ton drag.

Full instructions for slinging the gun will be found under "Machines," page 488.

The 64-pr. is the heaviest gun that the platform wagon is constructed to carry. The different methods of placing it on the wagon will be found under "Machines," page 513.

The method of constructing a temporary sleigh round the gun will be found described under "Temporary Sleighs," page 631.

The method of moving the gun on rollers will be found described under "Elementary," page 461.

80-PR. R.M.L. CONVERTED GUN.

The 80-pr. R.M.L. gun may be transported by land by the following means:—

1. By railway trolley.
2. By 5-ton gun drag.
3. By sling wagon.
4. By sleigh.
5. On rollers.
6. By parbuckling.

1. *By trolley.*—The same remarks apply as with 64-pr.

2. *By drag.*—Ditto.

3. *By sling wagon.*—Either the W. I. sling wagon intended for 7 tons, or the wooden sling wagon (with W. I. fittings to carry 6 tons) might be used; for instructions, *vide* "Machines," page 502.

Moving Guns (7 and 9-inch).

Section II.

4. *By sleigh.*—The same remarks apply as with a 64-pr.
5. *On rollers.*—Ditto.
6. *By parbuckling.*—Ditto.

7-INCH R.B.L. GUNS OF 72 AND 82 CWT.

The same remarks apply as with the 80-pr. R.M.L. converted gun, with the following exceptions:—

When transported by sling wagon, it is immaterial whether the wagon has fittings of wrought or cast iron, as with these guns either are sufficiently strong.

They are very awkward guns to move on rollers, on account of the coils, and for the same reason it is constantly necessary when parbuckling to cut forward the muzzle in order to keep one coil on the breech skid, otherwise the skids are soon destroyed. With the 82-cwt. gun it is best to keep the breech skid under the strengthening coil.

7-INCH R.M.L. GUN OF 7 TONS.

The 7-inch R.M.L. gun of 7 tons may be transported by land by the following means:—

1. By railway trolly.
 2. By heavy gun drug for 25 tons.
 3. By W.I. sling wagon for 7 tons, or two wooden sling wagons.
 4. By sleigh.
 5. On rollers.
 6. By parbuckling.
1. *By trolly.*—The same remarks apply as with 64-pr.
 2. *By drug.*—The same remarks apply as with 64-pr., but the heavy drug would have to be made use of, and the total weight would then be so great that, except over especially hard and level surfaces, it would be too great for horse draught.
 3. *By sling wagon.*—The W.I. sling wagon for 7 tons would have to be employed, unless the gun was slung from two wooden sling wagons, as described for 9-inch, page 509; as regards draught, *vide* remarks in transporting by drug, page 581.
 4. *By sleigh.*—The same remarks apply as with 64-pr.
 5. *On rollers.*—W.I. guns are awkward to move on rollers, except for very short distances, on account of the coils.
 6. *By parbuckling.*—*Vide* "Elementary," page 455.

N.B.—Should occasion require it, heavy guns may be moved short distances to front or rear on rollers, applied one under the breech coil and the other under the short coil or chase, the muzzle roller being raised off the ground to a height sufficient to keep the axis of the gun horizontal, a steadying lever being either lashed across the trunnions or placed through the breeching loop, and wedged up. The gun is then moved with a tackle, rollers being readjusted as required.

Section II.

Moving Guns (10-inch).

9-INCH R.M.L. GUN OF 12 TONS.

The 9-inch R.M.L. gun of 12 tons may be transported by land by the following means:—

1. By railway trolley.
2. By heavy gun drag for 25 tons.
3. By two sling wagons.
4. By sleigh, temporary or permanent.
5. On rollers.
6. By parbuckling.

1. *By trolley.*—The gun may be parbuckled on and off the trolley in the manner described at page 459, Elementary, or raised with one 18-foot heavy or two 18-foot light gyny, and the trolley run underneath.

2. *By drag.*—The gun may be parbuckled on to the drag, or raised with one 18-foot heavy or two 18-foot light gyny, and the drag run under it. With regard to the advisability, or otherwise, of transporting such heavy guns on drags, see General Observations, page 581.

3. *By two sling wagons.*—*Vide* page 509, "Machines." A few sling wagons have been constructed to take 12-ton guns, but no more will be manufactured, and those in store will be retained for use in arsenals.

4. *By sleigh.*—For instructions regarding the construction of temporary sleigh for 9-inch guns, see page 632. New pattern permanent sleighs have "flush" transoms, and, consequently, guns may be readily parbuckled on and off them, as described for trolley. The O.P. sleigh has a hollowed out centre transom into which the gun descends with great force in parbuckling on to the sleigh, unless proper check tackle be made use of, and in parbuckling off it is a heavy pull to get the gun out of the hollow. The gun may be raised with one 18-foot heavy or two 18-foot light gyny, and the sleigh run under it.

5. *On rollers.*—Same as 7-inch.

6. *By parbuckling.*—*Vide* Elementary, page 457.

10-INCH R.M.L. GUN OF 18 TONS.

The 10-inch R.M.L. gun of 18 tons may be transported by land by the following means:—

1. By railway trolley.
2. By permanent sleigh.*
3. By parbuckling.

* Temporary sleighs are sometimes constructed for these guns, as described at page 634.

Moving Guns (25, 35 & 38-ton Guns).

Section II.

1. *By trolly.*—The gun may be parbuckled on and off the trolly in the manner described at page 459, Elementary, or be raised with two 18-foot heavy gyns, and the sleigh run under it.

2. *By sleigh.*—Same remarks apply as with trolly. When parbuckling on or off a sleigh, with hollowed out centre transom, the special points noted in similar operations with 9-inch gun should be attended to.

3. *By parbuckling.*—*Vide* "Elementary," page 457.

11-INCH AND 12-INCH R.M.L. GUNS OF 25 TONS.

The 11-inch and 12-inch R.M.L. guns of 25 tons may be transported by land by the following means:—

1. By railway trolly.
2. By permanent sleigh.
3. By parbuckling.

The same remarks apply as with the 10-inch R.M.L. gun, page 584.

35 AND 38-TON GUNS.

Transport on Land.

There are three methods of conveying these guns from place to place, viz.:—

1. By railway trolly.
2. By permanent sleigh.
3. By parbuckling.

1. *By Trolly.*—Where trolly and tramway of sufficient strength are available, it is best to use them, as the guns are easily parbuckled on and off the trolly (if not lowered on to it by sheers), and a great saving in time and labour is effected, especially when a traction engine is available to draw the load.

If drawn by manual labour, from 60 to 100 men would probably be required. The former number for the level and straight; the latter for sharp curves and inclines. The gun should be well scotched up, and its weight distributed by skidding, as far as possible, over the trolly. Greasing the flanges of outer wheels and inner rails will facilitate the traction round curves.

2. *By Sleigh.*—The O.P. heavy service sleigh, though only designed for guns of or under 25 tons, is capable of transporting guns of 35 and 38 tons, if the precaution be taken to distribute the weight over the sleigh. To effect this, the gun should be skidded so as to bear at chase and cascable, as well as at the breech coil.

To avoid unduly straining the sleigh, four rollers at least should be placed under it, viz., one taking, one leaving, and two intermediate.

The 7-foot or 8-foot 12-inch iron-bound oak rollers are the best for the purpose, when the gangway is wide enough; but when

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Moving Guns.

space is restricted, the 6-foot 10-inch elm rollers will be found more convenient; one or two extra rollers may then be kept under the sleigh to relieve the pressure on them.

Three methods of placing the gun on the sleigh present themselves.

The first, in which the gun can be lowered straight on to the sleigh by sheers, calls for no special remark.

The second, to raise the gun high enough to enable the sleigh to be run under it, when the following plan may be adopted:—

An 18-foot heavy gyn is placed over the cascable to raise the breech, and the muzzle is raised by a jack.

As in these operations the gyn will be generally taxed to its extreme limit, greater care should be taken in the examination of the tackle than usual.

In this operation, if the distance from the centre of gravity of the gun, which lies in the axis of the trunnions, to the supporting skid under the short coil, which acts as the fulcrum when raising the breech with the gyn, be made one-half the distance from the centre of gravity to the cascable, the gyn will have to support one-half the weight that the beam does, or, in the case of a 38-ton gun:—

The gyn takes. . . . .	..	..	12 $\frac{2}{3}$ tons.
The beam . . . . .	..	..	25 $\frac{1}{3}$ „
Total . . . . .	..	..	38 tons.

The ring and shackle on the button of the cascable form the best means of attachment for the gyn tackle.

In raising the gun, the axis must not be allowed to get much out of the horizontal, and all usual precautions, as to following up with skidding and scotches, must be taken.

As, when raising the muzzle with the jack, the skidding under the breech coil forms the fulcrum, or fixed point, the gyn tackle must be left free to allow the cascable to descend.

The 38-ton gun is so long in front of the centre of gravity that the jack at the muzzle can never have a greater lift than 13 tons, even when the breech skidding is placed at the cascable, which would not be necessary.

The gun being raised high enough (which must depend on the thickness of the roadway and the diameter of the rollers which it is intended to make use of under the sleigh), a sound 20' x 15" x 15" fir skid is placed under the short coil, close in front of the breech coil, and supported on each side of the gun by cross-built skidding, leaving a clear gangway of 6 feet 6 inches, which will admit of the sleigh being run under the gun on 6-foot elm rollers, 10 inches in diameter, the breech being held suspended by the gyn.

Supposing the sleigh now run under the gun till its centre is under the axis of the trunnions, and its upper surface just clear of the under surface of the 20-foot skid (under the short coil), short

Moving Guns.

Section II.

oak skidding must be built up to within about 3 inches of the breech, which may then be lowered by means of the gyn tackle until it bears on the skids. Then scotch up and raise the muzzle with jack, remove long skid, and build up to within 4 or 5 inches of the gun; lower by jack on to the skidding, scotch up, and remove jack. Then raise breech by gyn, lower breech skidding, lower the breech as before, and so on, lowering breech and muzzle alternately, until the lower surface of the breech coil just touches the sleigh. Then skid up with oak under the shackle-ring, and place a 6' x 12" x 12" fir skid across the sleigh to receive the chase. By now lowering off until the gun takes its bearing, its weight will be pretty fairly distributed; large scotches may be jammed in on either side of the breech coil.

Removing the gun from the sleigh is the converse of the foregoing.

The object in employing 6-foot 10-inch rollers, instead of the 8-foot 12-inch rollers, is to lessen the distance between the points of support of the cross beam.

The sleigh can be easily made to travel from off the former on to the latter rollers by arranging these on a roadway at a 2-inch lower level, or practically at a 3-inch lower level, on account of the compressibility of the material of which the roadway is constructed.

The third method is to roll or parbuckle the gun on to the sleigh (if N.P.), in the same manner as described at page 459.

The reason that these heavy guns are not rolled on to and off the O.P. heavy service sleighs is that the receiving transom of the sleigh is hollowed out, which renders the operation an undesirable one, unless skidding is interposed between the gun and the sleigh.

It is, as a rule, advisable to place the gun on the sleigh with its centre of gravity over the centre of the sleigh. With these heavy guns, a long 9-inch rope sling passed over the gun, under the trunnions, and away to the block used to move the mass, is a handy mode of attachment; a thimble being fitted to receive the hook of the block.

The employment at Shoeburyness of the tramway turntables to slew the gun and sleigh into a new direction has been found very convenient.

The application of levers or jacks to raise the weight of the sleigh is occasionally necessary when the rollers require readjustment.

The roadway used under the rollers may consist of fir skids, 20' x 15" x 15", which answer very well. It is not necessary when using these heavy skids, on good ground, to break joint.

A roadway of 3-inch oak planks, three in a row, evenly supported by fir planks, laid transversely 2 feet apart, answers very well, and saves both labour and time. Local circumstances, however, must determine the exact nature of roadway which it may be most desirable to employ.

A tackle, consisting of one double and one single 18-in. Both-
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Section II.

Moving Guns.

way blocks, rove with 6-in. fall, and the running end taken in by a crab capstan, or crab winch, will be found to afford ample power for hauling the gun and sleigh along the level; the "double" block being moveable.

Should speed of motion be a desideratum, the rate of progression may be doubled by employing a second crab capstan or winch to take in the fall from the other end (the "standing" end) as well.

In rising inclines, the power must be regulated by the slope; nothing therefore can be laid down, but by making use of two tackles, each consisting of one treble and one double Bothway blocks, having their falls taken in by strong winches, a motive power of about 25 tons may be exerted, which would, in all probability, be found ample in any case that might arise; the "treble" in this instance being the moveable blocks.

As the same principles regulate the mode of procedure in changing direction, whether by cutting the rollers, or by slewing with these, as with other sleighs, the subject need not be remarked on, except that larger curves must be taken; but in bringing a gun on a sleigh into a casemate, where space is very restricted, it is often necessary to move the mass laterally to either one side or the other, especially when the gun has to be placed exactly in one position, as in the case before raising by the "box-beam." This may readily be effected as follows:—

To cut the front part of the sleigh at *c d*, Figs. 1 and 2, square to the left, greased coins are jammed in under the side pieces of the sleigh, as shown in the diagrams, the weight having been lifted by jacks for the purpose.

On easing down the jacks, the front of the sleigh will probably be found to slide down the incline to the left of its own accord. Should it, however, not do so, a pull with a tackle, or shove with a jack, will start it.

A check skid should be placed to prevent the sleigh slipping too far down the incline.

The following plan has also been found convenient, used either by itself, or in connection with that last described.

Jack up the end of the sleigh to be traversed, remove rollers, and place the beam *a b*, Fig. 1 and 3, as shown in diagram, at right angles to the side pieces of the sleigh, and apply a number of 5-in. sabicu shifting rollers underneath, for the beam to run on. The end of the sleigh can then be easily pulled towards either *a* or *b* by means of a tackle. The rollers if not on a hard surface should be supported by planks.

A sleigh with a heavy gun on it can be easily righted, if one side sinks lower than the other, on the same principle as slewing the trunnions of a gun, viz., by placing a 20' x 15" x 15" skid across the gun through a sling which is passed under and round the sleigh and attached to the upper trunnion; power being applied by means of a jack under the end of the skid, the latter acts as a lever. The ground should, if necessary, be loosened on the higher side.

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Fig. 1.

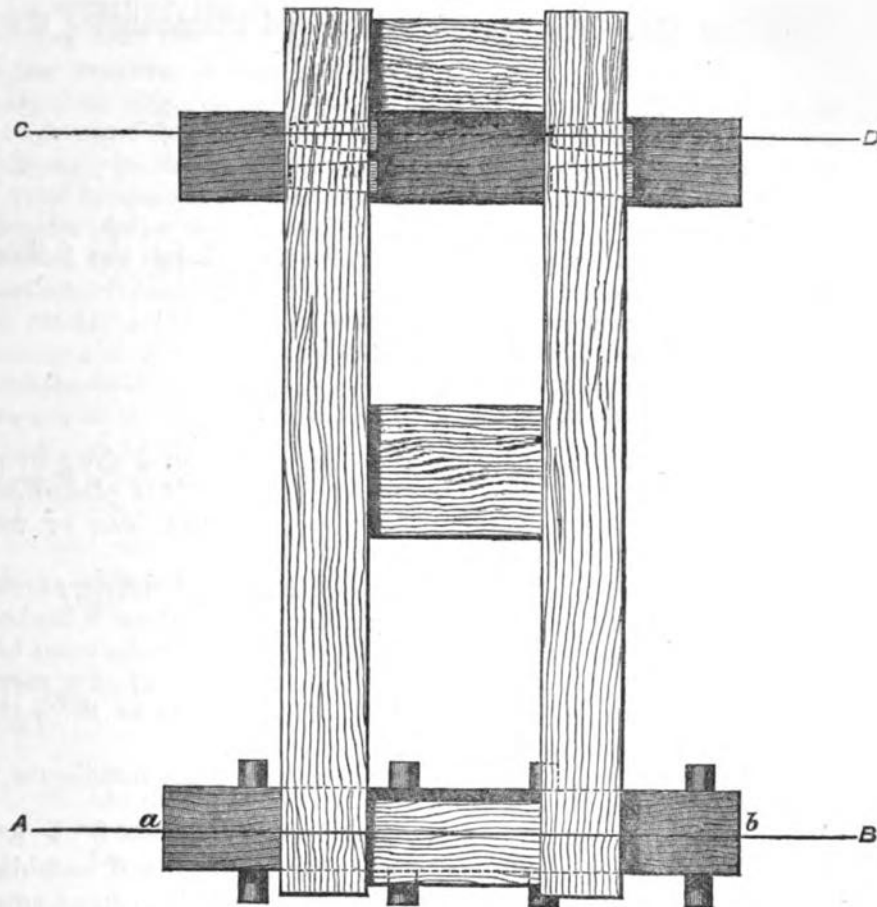
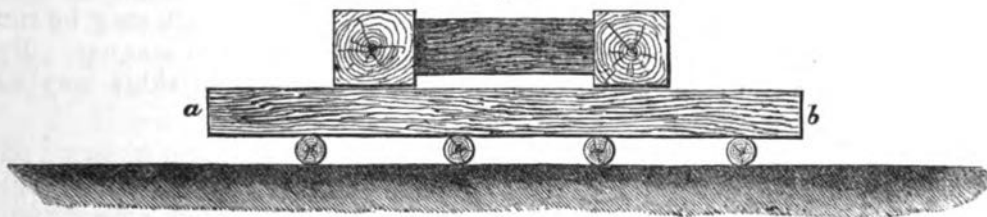


Fig. 3.



Section at A B.

Fig. 2.



Section at C D.

Section III.—Moving, Mounting and Dismounting Gun Carriages.

WOODEN SLIDING CARRIAGES.

MOVING.

Wooden sliding carriages may be moved by the following means.

1. By drag or platform wagon.
2. By transporting axle and dilly.
3. On temporary sleigh.
4. On long skids, using truck levers.

1. *By drag*.—The carriage may be placed on a drag or platform wagon either in the same manner in which it is placed on its platform, or it may be lifted with a gyn, and the drag or wagon run under it.

2. *Transporting axle*.—For transporting wood sliding carriages short distances on good roads, a round iron axletree 3 inches in diameter, is passed through a hole for the purpose in the front block, upon this two wheels are placed, and the rear of the carriage limbered up to a dilly, the pintail of which passes through an eyeplate in the rear block.

The perch of the dilly is fitted with a cross handle for man draught, and a ring for a drag rope.

3. *Temporary sleigh*.—Long skids (such as 14' × 8" × 8" fir) are placed, one on each side, under the brackets, and outside the guide blocks, the ends lashed together to keep them from opening out, and ground rollers applied under them.

4. *On long skids*.—By placing long skids the same distance apart as the side pieces of the platform, the carriage may be run along them by applying the truck levers in the usual manner. By lifting one side of the carriage at a time, the long skids may be launched forward as required.

MOUNTING AND DISMOUNTING.

Mounting and dismounting.—In mounting and dismounting these carriages on or from their platforms, there are two methods of proceeding, viz. :—

1. By long skids up or down the rear.
2. By long skids up or down the side.

1. *By long skids up or down the rear*.—This closely resembles the like operation with W. I. sliding carriage, described at page 593, but is less difficult from there being no buffer on the platform or

Dismounting Gun Carriages.

Section III.

flange on the carriage. The most suitable skids would be 14' x 8" x 8" or the 20' x 9" x 9" fir skids.

In mounting, the skids must be kept under the brackets of the carriage, until the rear guide block is in front of the rear stops, and the converse in dismounting.

By long skids up or down the side.—Sometimes from want of space in rear, the carriage has to be mounted up the side of the platform. In this case, the long skids are applied under the front and rear blocks of the carriage, watered, and the carriage hauled on to the platform and lowered into position.

From the slope of the platform, the carriage will, during the operation of hauling up, have a constant tendency to work off the long skids to the front; this may be checked by a few men exerting a steady strain in the contrary direction by means of a dragrope hooked into the eyebolt on the rear transom of the carriage, or the front of the platform may be skidded horizontal.

N.B.—In casemates it is sometimes convenient to mount these carriages by means of a tackle suspended from the overhead bolts.

WROUGHT-IRON SLIDING CARRIAGES.

MOVING.

Wrought-iron sliding carriages may be moved by the following means:—

1. By drug.
2. On their platforms, using transporting axle and dilly.
3. On temporary sleigh.
4. On long skids, using iron pointed levers.

1. *By drug.*—The carriage may be placed on a drug, either in the same manner in which it is mounted on its platform, page 593, or it may be lifted with a gyn and the drug run under it.

2. Instructions will be found at page 598 concerning the transport of wrought-iron carriages on their platforms by means of transporting axle and dilly.

3. In constructing a temporary sleigh for the carriage, it must be borne in mind that the buffer flange, or bracket, in front, under the middle of the breast of the carriage, projects, as a rule, very nearly nine inches below the bottom plate, therefore, to enable this flange to clear the rollers, nine inches of skidding must be applied under each bracket, and outside the angle iron guide plates of the carriage.

If fir skids 20' x 9" x 9" are made use of for the side pieces of the sleigh, the required height is obtained at once, but should their length be likely to occasion inconvenience, fir skids 14' x 8" x 8" may be used instead, with three inches of skidding under the carriage brackets on each side resting on the long skids.

Section III.

Moving, Mounting, and

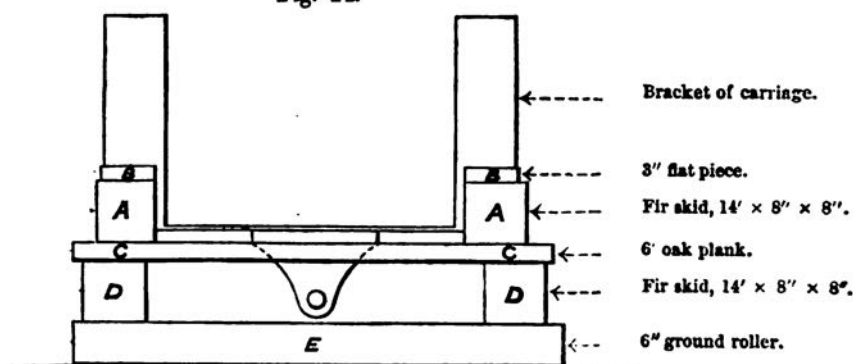
The ends of the long skids are lashed to prevent their opening outwards, and ground rollers are placed underneath them, on which the sleigh travels.

4. In a similar manner as described at 4, page 590.

From the construction of the Mark II. or "Scott" sliding carriage (for the 10-inch R.M.L. gun), with a well in the centre projecting 10 inches below the underneath surface of the carriage brackets, and a buffer bracket in front, projecting nearly 12 inches below that again, it would, perhaps, be more convenient to move them on a drag than on a sleigh, yet as a drag might not be available, or should the necessity arise for running such carriages into confined places in casemates, it is as well to indicate how a temporary sleigh might be constructed for their conveyance.

A fir skid, A A, 14' x 8" x 8", is placed under each carriage bracket outside the well or box, having three inches of skidding, B B, interposed between the skids and the brackets on each side, Fig. 14. The ends of the long skids are lashed together to keep them from opening out, three 6-foot oak planks C are now placed underneath and across the long skids, one a little in front, one a little in rear, and the third under the middle of the carriage. The two outer planks may be lashed for security to the skids above them; under the oak planks are placed the two fir skids 14' x 8" x 8", D D, and secured by lashing to the planks, and under the skids the 6-inch ground rollers, E, on which the sleigh travels.

Fig. 14.



Front elevation of "Scott" carriage on temporary sleigh.

Other skidding might be employed for constructing the sleigh. The foregoing detail is merely given as a guide as to what would usually prove the most convenient plan of proceeding.

TO MOUNT OR DISMOUNT A W.I. SLIDING CARRIAGE BY LONG SKIDS UP OR DOWN THE SIDE OF A PLATFORM.

This operation has sometimes to be resorted to from want of space to mount or dismount the carriage up or down the rear, and may generally be effected as follows:—

Dismounting Gun Carriages.

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Place an oak skid 5' x 6" x 5" under each bracket of the carriage, outside the angle iron guide plates, and strongly lash the ends together to keep them from opening out. The object of these skids is to keep the angle iron guide plates of the carriage from contact with the long skids up which the carriage is hauled on to the platform.

Form an incline with two long skids having their upper ends resting on the side of the after part of the platform, and their lower ends bevel down on the ground, and at such a distance apart that they may take a bearing under the ends of the short oak skids, before referred to; lash and water long skids, and haul carriage, with tackles, up on to platform.

The long skids may be so arranged as to revolve round the edge of the platform on which they rest (as the carriage passes beyond the point of support), and so to span the platform.

To Dismount the Carriage

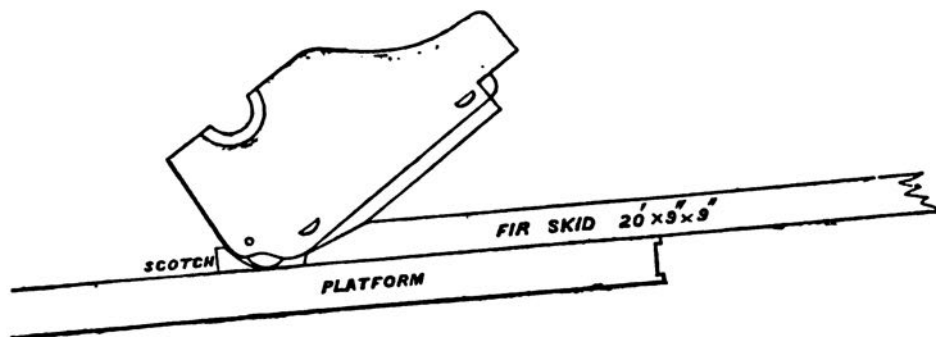
Is the converse of the foregoing.

TO DISMOUNT A W.I. SLIDING CARRIAGE FROM ITS PLATFORM DOWN THE REAR ON LONG SKIDS.

Disconnect carriage from buffer, slide piston rod of buffer back into the cylinder, and replace nut. Remove clip plates.

Run back to rear stops, scotch up front trucks, apply long levers to raise the rear of carriage till high enough to admit of a fir skid 20' x 9" x 9", being launched, bevel up, under each bracket; the skids should be placed far enough forward for their ends to come in front of the centre of gravity of the carriage, so that when the levers are removed the carriage will rest fairly on the skids (*vide* Fig. 15).

Fig. 15.



To effect this two or more lifts may be taken with the levers, keeping what is got by skidding up under the rear of the carriage. If 14' x 8" x 8" skids are used, it will be necessary to place a 3-inch plank under each, in the direction of its length, to enable the buffer bracket of the carriage to clear the buffer, when

Section III.

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moving the carriage to the rear. Now raise one side of the carriage, by applying a long lever under the front eyebolt, and a 7-foot handspike under the rear, and launch the skid so far to the front that when iron pointed levers are applied, the front truck of the carriage may be thrown into bearing on the upper surface of the skid; do the same on the other side, and the carriage will be ready for running to the rear.

The skids should be parallel, and at such a distance apart that their inner edges just clear the angle iron guide plates of the carriage; to keep them so, two 7-foot handspikes may be lashed under them, one close in rear of the platform, the other further back near their ends.

Iron-pointed levers are applied and the carriage hauled to the rear; as it passes beyond the rear of the platform, the skids may be allowed to dip till their lower ends bear on the ground. As they dip, the iron-pointed levers "come up," and are afterwards used to ease the carriage quietly down to the ground.

The carriage may, if desired, be passed by this method straight from the platform on to a drag in rear.

Should the fittings for the running back gear not have been removed from the rear of the platform, it will be necessary, to enable the flange of the carriage to clear them, to place planks across the platform underneath the long skids, which planks must be two or three deep, according to the height of the fittings to be cleared.

The best way of effecting this is to raise the outer ends of the long skids, and place a plank under them across the platform, and as far under the carriage as possible, then bear down the ends of the skids, which will raise their front ends high enough for another plank to be placed under them, about the breast of the carriage, then raise the rear, and insert another plank over the one first placed, and so on, until sufficient height has been obtained.

Another method of getting the long skids in position under the carriage when ready for raising, is as follows:—

One side of the carriage is raised at a time, by applying a long lever under the front eyebolt, and a 7-foot handspike under the rear eyebolt. At each lift, skidding or planking is inserted between the underneath surface of the bracket and the platform. In doing this care should be taken to apply the levers and handspikes as nearly horizontal as possible, using a fair amount of counter-lever, or the carriage will be slewed to a flank as soon as the guide plates clear the platform.

When high enough, the long skids are launched under the carriage from the rear.

The rest of the operation is the same as before described.

To Mount the Carriage

Is the exact converse of the foregoing.

Dismounting Gun Carriages.

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TO DISMOUNT A MARK II. W. I. SLIDING CARRIAGE (10-IN. 18-TON GUN), "SCOTT" PATTERN, BY LONG SKIDS DOWN THE REAR.

1st Method.

The peculiar construction of this carriage necessitates some modifications in the method of procedure in mounting and dismounting just described for W. I. carriages of the ordinary type. One advantage is, that with the platforms for carriages of this pattern, the fittings for the running back gear do not project above the rear transom. Still the shape of the carriage (*vide* page 592) requires that it should be raised to a height of at least 23 inches before the buffer bracket will clear the rear of the platform in dismounting, and, as skidding the carriage up to this height above the platform, would result in instability, without a foundation of planks placed across the platform as a ground work, the following method has been devised to meet the difficulty. The carriage is disconnected from the buffer, the piston-rod slid back into the cylinder and the nut replaced on the rod. Clip plates are removed.

Then raise carriage, one side at a time, as described in last case, and so skid up as to be able to place a couple of fir planks 10' x 17" x 3" across the platform, under the well of the carriage, one plank being close in rear of the buffer bracket, the other under the after part of the well, also two more planks close in front and rear of these again. These four planks form the foundation on which the future skidding is built up. Continue raising carriage and building up under the brackets, till high enough to place a fir skid 6' x 12" x 12", with a 3-inch plank underneath, under each bracket; the carriage is further raised till a fir skid 20' x 9" x 9" can be launched from the rear under each bracket, the forward portions of the long skids resting on the 6-foot fir skids, and being supported further back on 4' x 12" x 12" skids resting on fir planks placed across the after part of the platform.

The 4-foot fir skids last referred to should not overhang the rear of the platform; to avoid their doing so, it may be necessary to shift the 6-foot skids a little to the front. The carriage is hauled to the rear and dismounted, as previously described in dismounting carriages of the ordinary type, and the same precautions as with them may be taken to keep the long skids the proper distance apart.

To Mount the Carriage

Is the converse of the foregoing.

Should the carriage have been brought in rear of the platform on the temporary sleigh, previously described, page 592, for this pattern carriage, it might be found convenient to haul it up on to the platform on long skids and ground rollers.

Section III.

Dismounting Gun Carriages.

TO DISMOUNT OR MOUNT A "SCOTT'S PATTERN" CARRIAGE.

2nd Method.

When an 18-ton gun is mounted on a low carriage of "Scott's Pattern," it must be raised out of or lowered into the trunnion holes with the elevating arcs on. This may sometimes be effected by skidding up the gun under the short coil and lifting the breech with an 18-foot heavy gyn till high enough, but it not unfrequently happens that the arcs will jam when this is attempted, owing to the gun revolving round a centre other than that with which the arcs were struck (the axis of the trunnions); should any difficulty be experienced from this cause the following plan may be adopted for removing elevating gear.

Run the gun back till the muzzle falls within the shield, remove clip plates, disconnect carriage from buffer, depress as much as possible, skid up on the bottom of the carriage under the breech, between the elevating arcs, raise the muzzle with jack until high enough to get a 4-inch piece in each trunnion hole under the trunnions, lower and remove jack, depress as far as possible and remove the pinion, worm, and friction wheels of the elevating gear; the arcs and patches will have to be left on until the breech has been still further raised.

Now elevate, run up to front stops, skid up under chase on port sill, raise breech with an 18-foot heavy gyn, remove arcs and patches, run carriage back to rear stops, place skidding on and across platform to receive breech of the gun, lower on to it and scotch up. The gyn is now moved towards the rear of the platform for the purpose of raising the carriage, which may be slung with drag ropes; by placing the head of the gyn a little in rear of the centre of gravity of the carriage the latter is moved to the rear as it is lifted.

A luff tackle on either side between the front eye bolts of the carriage and platform serves as a check to keep the buffer bracket of the carriage from swinging on to the buffer. The carriage may now be lowered to rest on planks placed across the platform to receive the well or box; the position of the gyn is shifted still further towards the rear of the platform, and the operation repeated until the carriage can be lowered clear of the platform or on to a drag.

Replacing the carriage is the exact converse of the foregoing, but may be done by lifting the carriage in rear of the platform, with the gyn or levers till high enough to run it to the front on skidding arranged as described at page 595.

Should it be required to dismount the gun it may be moved to the rear on rollers as described at page 549, until the muzzle falls inside the shield, and then dismounted in the usual manner.

Moving Traversing Platform.

Section IV.**Section IV.—Moving, Mounting, and Dismounting
Traversing Platforms.****WOODEN TRAVERSING PLATFORMS.****MOVING.**

Wooden Traversing Platforms for the 64 and 80-pr. R.M.L. and the 7-inch R.B.L. guns may be moved by the following means:—

1. By transporting axle.
2. By sling wagon.
3. On temporary sleigh.
4. Upside down on rollers.

1. The same transporting axle and dilly described at page 590, serves for transporting wooden traversing platforms, the axletree passing through bands for the purpose, and the pintail of the dilly entering the bent plate between the sides in rear.

2. Wooden traversing platforms may be slung under a wooden sling wagon in the following manner. The wagon is run over the platform, shafts to the front, until the wagon windlass comes a short distance in rear of the centre of gravity. A 6-foot ground roller is placed across and under the platform immediately under the wagon windlass, the bights of the sling are passed under the ends of the roller, and the eyes secured in the usual way in rear of the wagon axletree bed: levers are worked, the platform raised as high as it will go and the front part of the platform lashed up to the perch. In the absence of a ground roller, the eyes of the sling may be lashed together under the platform and levers worked as usual.

With a dwarf traversing platform, the trucks and the rear block should be removed. *Vide* also 508.

**3. TO MOVE A PLATFORM, OR PLATFORM AND CARRIAGE,
STRAIGHT TO THE REAR, FROM UNDER A SUSPENDED GUN.**

This may be effected as follows:—

The platform is raised off its racers, front and rear alternately, until high enough for two fir skids, 14' x 8" x 8", to be placed underneath it, between the flanged feet of the trucks, resting on 6-foot ground rollers. Sufficient short oak skidding is interposed between the upper surface of the skids and the platform to bring the underneath surface of the long skids below the bottom of the trucks, which prevents their fouling the rollers as the platform is moved to the rear.

Section IV.

Moving, Mounting, and

4. TO TURN THE PLATFORM OVER.

Make fast four heavy dragropes, two for hauling on, and two for check ropes, and man them. Then man handle the platform up on to its side, the hauling ropes assisting, and the check ropes preventing the platform from passing beyond the vertical: ease it gently down on to skidding placed to receive it; the check ropes holding well on. When upside down, it is moved with great ease on ground rollers.

MOUNTING AND DISMOUNTING.

The method of mounting and dismounting platforms on or from their racers is sufficiently indicated in the foregoing descriptions, and needs no further remarks.

W.I. TRAVERSING PLATFORM.

Moving.

W.I. Traversing platforms may be moved by the following means.

1. By transporting axle.
2. On temporary sleigh with or without their carriages.
3. Upside down on rollers.

There are four transporting axles for iron platforms, of the same section in the body, viz., 4 inches square, with cylindrical arms, but differing in length as follows:—

Nature.	Total Length.		Weight.		
	ft.	ins.	cwts.	qrs.	lbs.
7" platform for double plate, or 7" and 9" single plate carriage	7	8	3	1	4
9" " plate carriage..	7	9½	3	1	6
10" " " " ..	8	8	3	3	5
11" or 12" (of 25 tons) .. " ..	9	11	4	0	8

Each axle is fitted with a pair of drag washers and keys, with rope ties as linch pins, and a draught chain is attached to the centre of it by a socket band.

The limber, or dilly, is fitted with a sweep plate in rear, and a pintail on the bolster, also with a keep chain and hook.

The splinter bar has a pair of frame shafts for single or double draught, a swingletree being also supplied for the latter.

A draught chain with a tongue and slip ring is attached to a bar on the rear of the dilly for connexion with the chain of the axle.

Dismounting Traversing Platforms.**Section IV.**

The 7-inch and 9-inch axles are sufficiently strong to take the gun, without its carriage on the platform, but this method of transporting the gun should only be resorted to on an emergency.

To transport a platform, or platform with carriage on it, the axle is placed through the iron bands for the purpose and keyed up, the platform raised till high enough to put on wheels.

The platform is then limbered up, and keep and draught chains made fast; the position of the carriage on the platform should be such as to give a small amount of the weight on the dilly.

With dwarf traversing platforms it is better to remove the rear trucks.

When it is desired to use the transporting axle with platforms not fitted with bands for its reception, or with eye for limbering up, the following course may be pursued.

The axle is secured by square lashings to the side pieces of the platform, and may be kept from moving to front or rear by fore and aft lashings passing from the front and rear transoms; two lashings in front and two in rear, applied close inside the side pieces of the platform, keep the axle square and in its place.

The axle should be so placed that but a small amount of weight falls on the dilly. When the carriage is on the platform, the position of the centre of gravity of the latter may, to a certain extent, be regulated by altering the position of the carriage.

To enable the platform to be limbered up, some such arrangement as the following may be made.

Skids are securely lashed underneath or above the side pieces of the platform (as most convenient), in the direction of their length, the ends converging and projecting beyond the platform at the end intended to be used for limbering up: over and across the projecting ends of these skids a short oak skid may be lashed. When limbered up the ends of the projecting skids rest on the shoulders of the bolster of the dilly and the cross skid lies just in front of the pintail. The dilly is secured by chain or rope to the platform, so that the draught does not fall on the cross skid in front of the pintail. With some platforms it may be found more convenient to secure the fore and aft skids nearer to the medial line of the platform.

TO MOVE A W.I. TRAVERSING PLATFORM ON A TEMPORARY SLEIGH.

See description at page 601.

TO MOVE A W.I. PLATFORM, UPSIDE DOWN, ON ROLLERS.

Turning the platform over is generally effected by gyn or overhead tackle in the following manner.

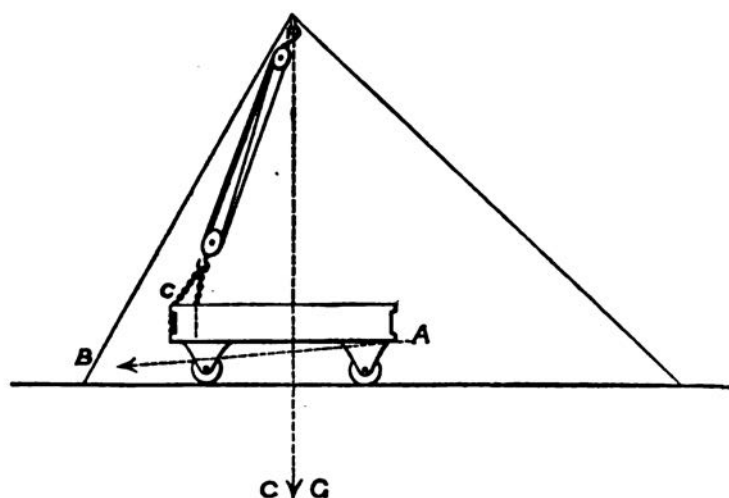
Section IV.

Moving, Mounting, and

The head of the gyn is placed over the centre of gravity of the platform. Fig. 16.

A chain strap or sling is applied as nearly as possible at the centre of gravity of the side piece of the platform next the cheeks of the gyn, at c; there should be sufficient slack or play in the chain strap to allow the hook of the lower block of the gyn tackle to slip round in it as the platform is turning over.

Fig. 16.



The centre of gravity will generally be situated a little in front of the head of the buffer, but it may be easily determined by experiment.

It is a good plan to have some of the returns of the chain strap in front and some in rear of one of the diagonals or stays of the platform to guard against a slip. Selvagees are attached to the front and rear eyebolts of the platform on the side opposite to the one to which the gyn tackle is secured, tackles are hooked into them, and their other blocks made fast to the gyn cheeks.

Levers are worked, and as soon as the platform is suspended, the side A is hauled up towards B; the gyn tackle is then eased off and the platform lowered on to skidding placed to receive it. Fig. 16.

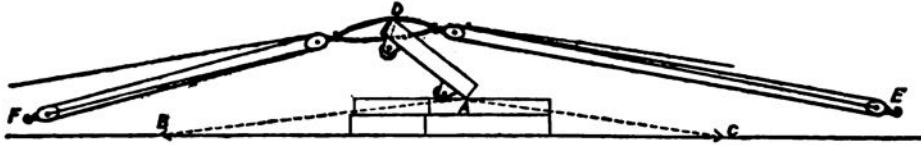
The platform should be so skidded throughout the operation that its projections lie or move clear of the supports, otherwise the skids will be injured, or damage done to the platform. Turning over a platform in a casemate by means of a tackle hooked into the centre overhead bolt is precisely similar in principle. An iron crab, double purchase, may be employed to take in the fall of the hoisting tackle. When upside down, platforms are readily moved on two ground rollers.

Instances may occur when it becomes necessary to turn over a platform without using a gyn or overhead tackle, but one of those methods should always, if possible, be employed.

Dismounting Traversing Platforms (7 and 9-inch).

Section IV.

Fig. 17.



Foot ropes, or tackles, should be made fast at each end of the platform, both in the direction A B, to act in raising, and in the direction A C, to act in lowering the platform. The side D is then raised with levers and skidded up as it rises, until high enough to be under the control of the hauling tackles D E; the check tackles D F are used to keep it in hand as it approaches the vertical, and for lowering on the other side. Fig. 17.

In lowering, the side of the platform should be received on skidding as soon as possible, i.e., at the greatest height to which it can be built in a thoroughly stable manner, and the lowering completed with levers.

The higher off the ground the standing blocks of the hauling and check tackles are made fast, the more will the platform be under control. Unless this operation be carried out with much care, the stays or fittings of the platform are liable to injury from coming in contact with the skidding.

MOUNTING AND DISMOUNTING.

The operations of mounting and dismounting W.I. traversing platforms on or from their racers, whether in open batteries or casemates, if carried out independent of the gun, need but few remarks. The platform would probably be brought into the emplacement on a transporting axle and lowered into position on the racers, or would be run into a casemate, upside down, on rollers, turned over by overhead tackle, and mounted.

When, however, it becomes necessary to remove a platform, or platform and carriage, from under a suspended gun, or the converse, it is usually effected by a temporary sleigh.

TO DISMOUNT A W.I. PLATFORM FROM ITS RACERS AND REMOVE IT TO THE REAR ON TEMPORARY SLEIGH.

In the case of a platform not fitted with traversing gear the operation may be carried out as follows:—

The platform is raised off the racers and skidded to a height sufficient to allow two fir skids, 14' x 8" x 8", to be placed fore and aft underneath it, close inside the trucks, and resting on two or three ground rollers, 6' x 6".

Sufficient short skidding is interposed between the fir skids and the platform transoms to bring the under surface of the former below the bottom of the trucks.

(A. M.)

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Section IV.

Moving, Mounting, and

With dwarf traversing platforms, it is more convenient to place fir skids, $6' \times 12'' \times 12''$, between the long skids and the platform, and to remove the trucks.

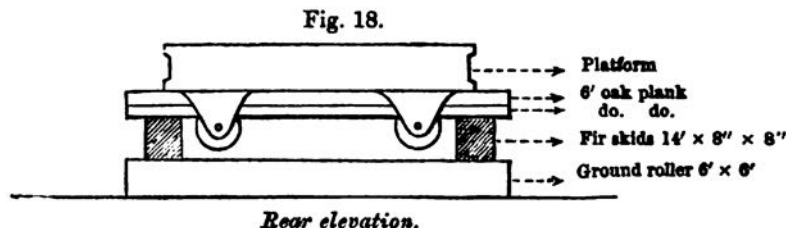
In this way the platform travels straight to front or rear very well, but if much cutting of rollers or slewing be attempted the skidding is liable to become displaced.

As a rule, however, the operation will have to be effected with a platform fitted with traversing gear.

The case of an "A" pivot platform will first be considered.

With 7-inch and 9-inch platforms, the following method has been found convenient:—

A fir skid, $14' \times 8'' \times 8''$, is placed close alongside each side piece of the platform on the outside, and resting on two or three ground rollers, $6' \times 6''$, Fig 18. The platform, if casemate, is then



raised till high enough to allow two or three 6-foot oak planks to be placed over the long skids and under the platform, close in front of the rear trucks, and one 6-foot oak plank to be placed in like manner close in rear of the front trucks. This will raise the platform high enough for the bottom of the trucks to clear the ground rollers. Short rollers may be used under each long skid if preferred.

With dwarf traversing platforms for these natures, fir skids, ($6' \times 12'' \times 12''$) would be used instead of the planks, and the rear trucks be removed, or additional skidding or planks placed over the fir skids to get extra height for the platform.

The A pivot casemate platform of the 10-inch, 11-inch, and 12-inch is always met with fitted with traversing gear.

To remove the gear is a work of time and labour, even for experienced artificers, and on sea fronts, where it may have been long exposed to the action of weather and salt spray those difficulties will be considerably aggravated, especially if it be attempted without turning over the platform.

The greater width of these platforms, their fish-bellied form, and the obstructions offered by the traversing gear will, generally necessitate some other arrangement being made for getting them to the rear, from under a gun, than that before described for the 7-inch and 9-inch platforms, but if 10-foot planks are procurable, a temporary sleigh may be constructed for the platform as described for 7-inch and 9-inch; or possibly 6-foot planks be made use of under and across the platform in front, and 10-foot planks in rear.

These platforms may also be moved by applying short rollers in close succession under the curve of the fish-belly on either side.

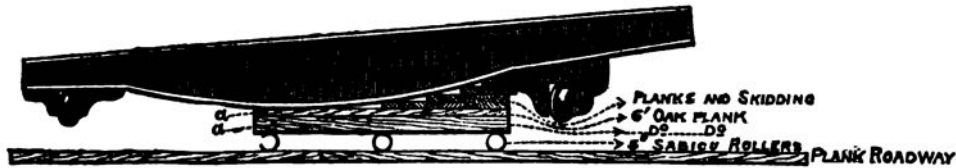
Dismounting Traversing Platforms (7 and 9-inch).

Section IV.

The following has in some cases proved a handy method.

Raise the platform till high enough to place two 6-foot oak planks, as in Fig. 19, on each side, under the platform, one end of the planks bearing against the curve of the fish-belly, the other being supported by cross planks, or a combination of planks and short levers, or baulks; in short, any scantling that can be most conveniently placed across to afford support to the planks.

Fig. 19.



Under the planks, *a a*, are placed short rollers which run on a plank roadway to clear the racers.

The position of the carriage on the platform should be such as to bring the centre of gravity of the system (carriage and platform) over the centre of the oak planks, *a a*.

When once the platform is clear of the gun it may be turned over, and moved upside down on rollers, or removed by means of the transporting axle and dilly.

Should there be room, a platform may be rowed to the rear, using two or more levers on each side.

TO DISMOUNT PLATFORM—C OR D PIVOT.

With either of these pivots, so much of the space underneath the platform is occupied by the shafts, wheels, &c., of the traversing gear, that it becomes necessary to resort to one of the following methods:—

1st. To remove the traversing gear, and then construct a temporary sleigh by one of the methods previously described.

2nd. To dismount gun and carriage, remove them clear of the platform, then remove platform by means of the transporting axle, or else to turn it over with a gyn and run it to the rear on rollers.

3rd. To construct a temporary sleigh for the removal of platform and carriage in the manner hereafter described.

The first and second methods call for no special remarks, the mode of proceeding being sufficiently indicated in the descriptions previously given.

If there are fittings on the curve of the fish-belly, they prevent the method already described of getting the platform to the rear from being carried out, and space may be wanting to admit of the platform being rowed to the rear with levers; a temporary sleigh may however be in some cases constructed in the following manner.

By removing the handle of the clutch lever, or some small fittings, space can generally be found near the rear part of the platform to place the transporting axle underneath and across,

(A. M.)

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Section IV. Dismounting Traversing Platforms, 10'', 11'', and 12''.

so as to ride clear of the fittings. The platform being raised in rear, the wheels are put on the axle, and if necessary planks laid for them to run on.

To support the front part of the platform, fir skids 14' x 8" x 8" are laid close alongside the side pieces, on the outside, each skid being supported on three or four 5-inch sabicu shifting rollers; the platform is then raised in front till high enough to admit of long fir planks, levers, or any scantling of suitable length and strength being placed across, underneath the platform and over the long skids, at as many points of support as possible. The carriage is run back to the rear stops to throw the weight, as far as may be, on the transporting axle. The platform is then moved to the rear.

Embarking and Disembarking Heavy Guns by Parbuckling. Section V.

Section V.—Embarking and Disembarking Heavy Guns by Parbuckling.**TO EMBARK A 25-TON GUN ON A FLUSH DECKED BARGE FROM A QUAY OR PIER, BY PARBUCKLING.**

A barge of sufficient beam, buoyancy, and strength, must first be selected, and the deck be well strutted from below in the centre where the weight will rest.

The places where the gun is to be embarked and afterwards landed should be carefully examined to see that there is sufficient water to allow of the barge, when loaded, being laid alongside.

Should it not be possible to obtain a barge of sufficient beam, size, and strength, the difficulty may be met by making use of two barges, side by side, spanned and secured by long stout beams or spars laid across both, and on which the required deck or superstructure is laid.

The number and strength of the holdfasts for the check parbuckle ropes to be employed in embarking the gun will depend on the slope down which the gun has to travel on to the barge, and it should be borne in mind that, even if the gun is started with the embarking skids horizontal, yet, before the operation is completed, a downwards slope will result from the vessel settling under the weight. All being in readiness, and proper holdfasts prepared, the barge must be securely moored alongside the place of embarkation at such a distance from the pier that when the shore ends of the 20' x 15" x 15" skids overlap the edge of the pier about 2 feet, their outer extremities may rest on the centre of the deck; by moving the barge closer in shore, the downward slope of the skids is made steeper, which may, in some cases, be objectionable.

The mooring should be such as to effectually prevent the barge from moving ahead, astern, out from, or in towards the shore.

The parbuckle skids should be fitted with 3-inch rope grummets at each end to enable them to be lashed.

The gun is parbuckled to near the edge of the quay or pier on skidding of sufficient height to allow of its being rolled off on to the long skids, which are arranged with their outer ends resting on oak planks placed athwart ship, in the centre of the deck, and with their inner ends overlapping the edge of the pier about 2 feet.

They should be securely lashed to the shore by ropes made fast to the rope grummets at either end.

Sufficient thickness of oak planking is laid on the muzzle skid to keep the axis of the gun horizontal; it is very important to observe this, for if neglected, the breech coil will only bear on the inner edge of the breech skid next the trunnions, which would, necessarily, be overtaxed, as, in operations of this nature, the parbuckle skids cannot be supported at intermediate points.

Section V. Embarking and Disembarking Heavy Guns by Parbuckling.

The muzzle skid, with oak on top, is arranged under the centre of the short coil, and the two breech skids are placed close side by side, with the inner edge of the inner skid about six inches in rear of the trunnions.

Short skids are placed in the centre of the deck to receive the gun, the upper surface of the breech skid about 18 inches above the deck.

The gun may be rolled on to the long skids by means of a $4\frac{1}{2}$ -inch parbuckle rope attached to one trunnion, and be kept in hand during its descent by three 6-inch parbuckle ropes, applied as follows:

One breech parbuckle rope, close in rear of trunnions with standing end made fast at holdfast, running end coming off under gun.

One muzzle parbuckle rope, on the chase, close in front of the short coil, applied in the same manner. One standing parbuckle secured to one trunnion. The object of this rope is to aid in controlling the descent of the gun, but chiefly, when hauled on, to enable the breech scotch to be cleared, after cutting forward the muzzle.

Either iron crabs, double purchase, or tackles, may be employed for easing off the check parbuckle ropes; if the latter, and the slope is steep, each tackle may consist of one double and one treble 12-inch Bothway block, rove with a half coil of 4-inch rope. The treble or moveable blocks can be most conveniently made fast to the running ends of the parbuckle ropes with a hawser bend. The descent is commenced with all three tackles "chock-a-block," the treble blocks being, if possible, about 40 feet back from the edge of the quay, which will obviate the necessity of having to shift the tackles during the operation; should, however, the holdfasts be of necessity so near the edge of the quay as not to render this practicable, one tackle only should be shifted at a time whilst the others hold on. If a round turn be taken with the running ends of the tackles round any convenient object, a few Nos. will be easily able to keep the weight well in hand.

A light gyn tackle may be used for cutting forward the muzzle, the standing block being secured to the barge, and the moveable block to a fid in the bore.

Great care should be taken in cutting forward the muzzle not to overdo it, as, although it is very easy to cut the muzzle forward down hill, it is difficult to bring it back again, and more especially so when, as in this case, it is awkward to get a lever to bear to aid in the operation. To guard against the muzzle being cut too far forward, the muzzle parbuckle rope should only be eased up a little, the standing parbuckle somewhat less, and the breech parbuckle less still.

Then, with breech scotched up, the muzzle is cut forward until the slack of the parbuckle ropes is taken in, and the same repeated if desired. The upper oak plank under the short coil has its upper

Embarking and Disembarking Heavy Guns by Parbuckling. Section V.

surface watered to lessen the friction. To clear the scotch under the breech a pull is taken on the tackle of the standing parbuckle and the scotch knocked out.

When the gun is fairly in position in the centre of the barge, scotch up all over, cast off parbuckle ropes, and remove long skids.

To secure the gun on the barge, it is well, especially if she has to be towed through a seaway, to drive an iron spike or two behind each scotch, and further to make fast a couple of tackles on each side, their single blocks attached to the gunwale, and their double blocks hooked into a strap hitched over the opposite trunnion. These means effectually guard against the gun shifting its position.

DISSEMBARKING FROM A BARGE.

This is the converse of the foregoing, but the muzzle skid should be further secured to the barge to prevent it from moving when the muzzle is cut forward, to facilitate which operation, greased iron plates or rails should be interposed between the oak planks and the short coil.

Iron crabs, double purchase, may be advantageously employed to take in the running ends of the parbuckle ropes (used without tackles), which, of course, lead off *over* the gun, and a crab capstan for taking in the running end of tackle for cutting forward the muzzle.

In disembarking a gun stowed below hatches it must first be jacked up, breech and muzzle alternately, fir skidding $6' \times 12'' \times 12''$ being carefully cross-built under it as it rises, until high enough to launch long skids $20' \times 15'' \times 15''$ across and underneath it, the deck being strutted underneath the points where the long skids rest; it is then parbuckled on to the shore.

If the points of bearing for the parbuckle skids cannot be placed in the centre of the barge, arrangements should be made to prevent her heeling over excessively.

If possible the lower ends of the parbuckle skids should rest on the centre of the long cross skids; in which case the latter should be placed in pairs, spanning the barge, one pair under the breech coil, the other under the short coil, and be supported in the middle.

Section VI. Moving, Mounting, and Dismounting Mortars.

SECTION VI.—Moving, Mounting, and Dismounting Mortars.

TO MOUNT OR DISMOUNT MORTARS ON THEIR BEDS.

Strength of detachment, 13-inch, 19 Nos.; 10-inch and 8-inch, the mortar detachment.

Stores required.

The stores belonging to the mortar and the following:—

Blocks of wood, about $4\frac{1}{2}$ " \times $4\frac{1}{2}$ " \times 8"	..	..	2
Dragropes, heavy	..	..	2
Handspikes	..	..	2
Hammer	..	..	1
Hemp waste, or a sand bag.			

TO MOUNT THE 13-INCH MORTAR.

Raise the mortar on its muzzle.

Heave.

Run the bed up.

Fix dragropes.

Heave.

Bring the mortar vertical.

Heave.

Place capsquares and coin.

"*Raise the mortar on its muzzle.*"—Nos. 10 and 11 make fast two dragropes to the trunnions; these are manned by all the Nos. above 5, on their own sides; 2, 3, 4, and 5, apply their handspikes under the trunnions, and No. 1 stands ready to push the coin under the breech as the mortar is raised.

"*Heave.*"—The mortar is brought on its muzzle.

"*Run the bed up.*"—The bed is run up until its front is within three inches of the mortar, and fair for the mortar to fall into it; some hemp waste or an old sandbag is placed on the edge of the front transom to receive the mortar.

"*Fix dragropes.*"—Nos. 10 and 11 each make fast a dragrope to the rear running up bolts, bringing them under the rear horns between the cheeks of the bed, then passing them under and over the trunnions, twisting them together, passing the running ends to the rear; which are manned by all the Nos. above 5; 2 and 3 apply their handspikes under the trunnions, resting the ends on the top of the bed close to the trunnion holes; these handspikes are double manned by 4 and 5.

"*Heave.*"—The dragrope Nos. heave till the trunnions fall into the trunnion holes; the handspike Nos. keeping the trunnions horizontal, the blocks of wood should be placed in the trunnion holes to prevent the ropes jamming.

Moving, Mounting, and Dismounting Mortars.**Section VI.**

"Bring the mortar vertical."—Nos. 2, 3, 4, and 5 place their handspikes in the bore; 10 and 11 make fast dragropes round the small ends of the handspikes, and pass them to the rear. Nos. 2 and 3 take a purchase with handspikes over the cheeks of the bed, and 6 and 7 stand ready to scotch up as the mortar is raised.

"Heave."—The mortar is brought vertical.

"Place capsquares and coins."—The capsquares are put on by Nos. 2, 3, 4, and 5, and the coin replaced by 6 and 7. The mortar is then lowered on to the coin, and the dragropes and handspikes removed.

N.B.—For mounting, the muzzle of the mortar, when vertical, should be on the same level as the bed.

TO MOUNT 8-INCH AND 10-INCH MORTARS.

This is performed in the same manner as described for the 13-inch, except the two highest Nos. fix the dragropes.

TO DISMOUNT THE 13-INCH MORTAR.

Bring the mortar vertical.

Heave.

Off capsquares.

Place capsquares.

Heave.

Shift dragropes.

Heave.

"Bring the mortar vertical."—2, 3, 4, and 5 place their handspikes in the bore; 10 and 11 make fast dragropes to the small ends of the handspikes and pass them to the rear. All the Nos. man the dragropes.

"Heave."—The mortar is brought vertical.

"Off capsquares."—2, 3, 4, and 5 remove the capsquares, and 6 and 7 the coin.

"Place capsquares."—6 and 7 place the capsquares, upper surface upwards, one end of each resting on the front transom close to the cheek, the other ends on a block of wood placed between the cheeks. 10 passes a dragrope to the front, which is manned by the 6 lowest Nos., the other Nos. man the rear dragrope ready to ease off.

"Heave."—The mortar is lowered gently on to the capsquares, which should be protected by some hemp waste or an old sand bag, this should raise the trunnions clear of the trunnion holes.

"Shift the dragropes."—The handspikes are removed, and the dragropes made fast by 10 and 11 to the trunnions. The whole of the Nos., except 1, 2, and 3, man the dragropes to the front.

"Heave."—The mortar is hauled over on to its muzzle.

TO PLACE 10 AND 8-INCH MORTARS AND THEIR BEDS ON TRENCH CARTS.

Strength of detachment, the mortar detachment.

Section VI.

Moving, Mounting, and Dismounting Mortars.

Stores required.

The stores belonging to the mortar and the following:—

Dragropes, heavy	..	..	..	..	2
Handspikes	..	..	..	..	2
Lashings, 2½-inch, for 10-inch mortar	..	..	..	..	4
„ 1½-inch, for 8-inch mortar	..	..	..	..	4
Scotches	..	..	..	..	4

A trench cart can carry a 10-inch mortar or its bed, or an 8-inch mortar and its bed.

TO PLACE A 10-INCH MORTAR ON A TRENCH CART.

The mortar must be placed on its muzzle as before.

Fix guy ropes.

Fix holding on ropes.

Heave.

Scotch and lash the mortar.

“*Fix guy ropes.*”—1 and 9 fix dragropes to the breeching rings of the cart, and make a clove hitch round the shafts about 6 inches from their point.

8 and 9 then run the cart back close to the mortar and raise the shafts until their butt ends rest on the ground, and the wheels are off the ground.

“*Fix holding on ropes.*”—8 and 9 fix a rope to each trunnion, and take two turns round the shafts and hold on.

“*Heave.*”—4 and 5 pass their handspikes under the trunnions, double manned by 2 and 3, and lift, all the other Nos. hauling down the shafts. As soon as the mortar is off the ground, 2 and 3 place their handspikes in the bore to lift, and with 4 and 5 heave the mortar forward till it rests in the centre of the cart and over the axletree.

“*Scotch and lash the mortar.*”—2, 3, 4, and 5, place their handspikes on each side of the mortar, the points to the rear; 6 and 7 scotch up. Nos. 2 and 3 then make fast lashings to the trunnions on the opposite side to that on which they stand, cross them over the top of the mortar, and take a turn round the butt end of the shaft and handspikes on their own sides, back again over the mortar and under the trunnions, over the mortar a third time, and round the butt ends of the shafts, frapping and making fast the whole of the returns in front of the muzzle.

4 and 5 cross the other ropes, which are already fixed to the trunnions, and take three turns round the shafts and trunnions, then frap and make fast.

TO LOWER AN 8-INCH OR 10-INCH MORTAR FROM A TRENCH CART.

This operation is the converse of the foregoing.

Moving, Mounting, and Dismounting Mortars.

Section VI.

TO PLACE A 10-INCH MORTAR BED ON A TRENCH CART.

Prepare to raise the bed on its end.

Heave.

Fix guy ropes.

Fix holding on ropes.

Heave.

Lash the bed.

"*Prepare to raise the bed on its end.*"—6 and 7 fix dragropes to the rear running up bolts, and pass them under the rear horns, bringing them up inside between the cheeks, and stretch them to the front, where they are manned by all the Nos. except the first four; 2 and 3 apply their handspikes under the rear running-up bolts; 4 and 5 stand ready with theirs to take a purchase, as soon as they can, under the rear transom of the bed.

"*Heave.*"—The Nos. haul until the bed is nearly on its breast, Nos. 1, 2, 3, and 9 move in to steady it; 4 and 5 at the same time place their handspikes under, and in front of, the front running-up bolts.

"*Fix guy ropes.*"—1 and 9 fix dragropes to the breeching rings of the cart, and make a half hitch round the shafts, about six inches from their points; the cart is then run back, the shafts raised.

"*Fix holding-on ropes.*"—8 and 9 fix the holding-on ropes to the rear running-up bolts, taking two turns round the shafts, and haul taut.

"*Heave.*"—The same as already detailed for the mortar; 2 and 3 take a purchase with their handspikes under the breast transom to lift, as soon as they can; 4 and 5 place their handspikes over the spokes of the wheels and under the cart.

2, 3, 4, and 5 then heave the bed on to the cart.

"*Lash the bed.*"—2 and 3 secure the front of the bed and 4 and 5 the rear, by each fixing a lashing to the running-up bolts, and taking two or three turns round the shafts and bolts, making the ropes cross from the bolts to the opposite shaft, frapping the returns together, and making fast with a reef knot.

TO DISMOUNT A 10-INCH MORTAR BED FROM A TRENCH CART

Is the converse of the above.

TO DISMOUNT A 10-INCH MORTAR FROM A TRENCH CART ON TO ITS BED.

The cart is placed in rear of the mortar bed, and at such a distance from it that when the shafts are raised the butt ends may rest on the upper surface of the cheeks of the mortar bed. Nos. 6 and 7 scotch the wheels.

Section VI.

Moving, Mounting, and Dismounting Mortars.

The mortar having been unlashed, the guys made fast, and the shafts raised, the holding-on ropes are eased off, and the mortar allowed to slide down gently; when its muzzle has arrived about the rear of the cart, 2 and 3 place their handspikes in the bore, and lift up the muzzle, 8 and 9 ease off, causing the muzzle to clear the breast transom, and continue doing so until the trunnions are over the trunnion holes, but not lodged in them, 4 and 5 place the points of their handspikes in the trunnion holes, for the trunnions to rest on, after which 8 and 9 cast off the holding-on ropes, 4 and 5 withdraw their handspikes, allowing the trunnions to fall into their places.

TO PLACE AN 8-INCH MORTAR AND ITS BED ON A TRENCH
CART.

The coin having been taken out and the mortar lowered on the bed, they are raised so as to rest on the breast of the bed and muzzle of the mortar, the operation of placing them on the cart is the same as already described for the 10-inch mortar bed. The coin is carried on the front of the cart between the cheeks of the bed, and secured by a lashing.

TO DISMOUNT AN 8-INCH MORTAR AND ITS BED FROM A TRENCH
CART.

The mode of proceeding is the same as for a 10-inch mortar or bed.

List of Stores.

Section VI.

**LIST OF STORES FOR MOUNTING, DISMOUNTING,
AND MOVING, &c., GUNS OF 18 TO 38 TONS.**

TRANSPORTING BY TROLLEY ON RAILS.

List No. 1A.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Grease, Fenner's (in pot) lbs.	..	2	General purposes.	
Handspikes, common ..	7'	6		
Planks, wood, moving guns, oak, half	6' x 12" x 3"	10		
Ropes, parbuckling, white, 18 fathoms	6"	2		
Scotches, wood, elm, large	1' x 6" x 6"	20		
Skids, wood, fir	6' x 12" x 12"	1		
Trucks, railway {	According to weight of gun.	1		

N.B.—1 winch or crab-capstan may be required.

**TRANSPORTING BY SPECIAL WROUGHT-IRON CARRIAGE ON
RAILS UP INCLINE (AT CLIFF END).**

No. 1B.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Blocks, snatch, iron .. {	Special for 1-in. chain	6	2 main chains 2 at crabs, half- way. 2 at top of in- cline.	
Carriages, wrought-iron, transporting	Special	1	For carrying guns.	

Section VI.

List of Stores.

TRANSPORTING BY SPECIAL WROUGHT-IRON CARRIAGE ON
RAILS UP INCLINE (AT CLIFF END)—*continued.*

List No. 1B.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Chain, iron, 12½-fathom lengths	1-inch	4	For main chains	
Cordage, tarred, hawser, 4-strand coils	9-inch	2	For brake-check rope.	
			For hauling.	
			2 half-way.	
			2 at top of incline.	
Crabs, iron, double-purchase, for hoisting heavy guns	5 tons	4	For hauling in slack of chain.	
	2 tons	4		
Holdfasts				
Lashings				
Mauls				
Pickets				
			{ General purposes }	As required.

TRANSPORTING BY SLEIGH.

List No. 2.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Blocks, wood { Admiralty, iron, bound, snatch	18-inch	2	Check rope and motive power.	
Both-way's { single	"	2		
	"	2		
	"	2		
Capstans, crab, complete .. .. .	..	2	For level.	
Cordage { tarred yarn, spun, hemplbs. white, hawser, 3-strand, coils of 113 fathoms	6-inch	2		
Crabs, iron, double-purchase, for hoisting heavy guns	2 tons	2	For inclines.	
Drivers, pile, Swiss, complete .. .. .	..	2		
Handspikes, common	7-feet	12		
Jacks, lifting, hydraulic, Tange's	10 to 20 tons	2	.. .. .	As required.
Lashings, 5 fathoms	2½-inch	12		
Levers, wood	14-feet	2		
Mauls, wood, { common .. .. .	..	2		
helved { iron hooped .. .. .	..	4		

List of Stores.

Section VI.

TRANSPORTING BY SLEIGH—*continued.*

List No. 2.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Planks, wood, { fir, whole..	10' x 17" x 3"	30	} For roadway.	On an incline sunken hold- fasts may be necessary.
moving guns { oak, { whole	10' x 17" x 3"	20		
{ half..	4' x 12" x 3"	1		
Posts, picket, garrison .. {	8-feet	9	} Holdfasts for level	
	5-feet	12		
Rollers, { elm	6' x 10"	8	For placing sleigh under gun.	
wood { oak, iron-bound	8' x 12"	8	For travelling.	
Ropes, drag, heavy	6	For following up incline.	
Scotches, { large	12" x 6" x 6"	20		
wood, elm { with handle ..	12" x 6" x 6"	6		
Selvagees	4	} Roadway and general pur- poses.	
Skids, wood { fir .. {	20' x 15" x 15"	6		
	6' x 12" x 12"	6		
	4' x 12" x 12"	6		
	5' x 6" x 5"	2		
	3' x 9" x 6"	6		
	3' x 6" x 3"	6		
	3' x 6" x 6"	6		
	3' x 3" x 3"	2		
Sleighs, transporting guns {	According to weight of gun	1	Attached to gun. Standing end of tackles, &c.	
Slings, white, { with thimbles	9-inch—16 feet	1		
rope, gun { without „	6-inch—12½ feet	4		
Wedges, wood, oak	18" x 12" x 2½"	6	For passing from one skid to another when not exactly of same level.	

TRANSPORTING BY PARBUCKLING.

List No. 3.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Blocks, wood { Admiralty, iron-bound, snatch	12-inch	2	} For cutting muzzle.	
	18-inch	2		
	Both- { double ..	1		
	way's { single ..	1		
Buckets, wood, sponge, {	..	1		
garrison .. .. .	..	1		

Section VI.

List of Stores.

TRANSPORTING BY PARBUCKLING—*continued*.

List No. 3.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Capstans, crab, complete ..	..	2		
Cordage, tarred, hawser, } 3-strand, fathoms ..	4-inch	56½		
Drivers, pile, Swiss, complete	..	2		
Grease, Fenner's (in pot) lbs.	..	2		
Handspikes, common ..	7-feet	8		
Jacks, lifting, hydraulic, } Tangye's	10 to 20-tons	1	.. .. .	As required.
Lashings, { white rope ..	2½-inch	2		
5 fathoms { tarred rope ..	2½-inch	6		
Levers, wood	14-feet	3		
Mauls, wood, { common ..	..	2		
helved { iron hooped ..	..	4		
Planks, wood, { fir, whole..	10' x 17" x 3"	28		
moving guns { oak, half {	6' x 12" x 3"	3		
	4' x 12" x 3"	2		
Plates, wrought-iron ..	3' x 7" x ½"	2		
			For placing over skids to ease moving for- ward the muzzle.	
Posts, picket, garrison {	5-feet	12		
	8-feet	9		
Rollers, wood, oak, iron } bound	8' x 12"	1		
Ropes { drag, heavy ..	..	6		
{ parbuckling, white	6" x 18 fathoms	2		
Scotches, wood, elm, large	1' x 6" x 6"	8		
Selvagees .. ..	..	2		
	20' x 15" x 15"	6		
Skids, wood { fir ..	6' x 12" x 12"	2		
	4' x 12" x 12"	2		
	3' x 9" x 6"	2		
	3' x 6" x 6"	2		
	3' x 6" x 3"	2		
Slings, { with thimbles	9" x 3 feet	1		
white rope, { without ..	6" x 12½ feet	2		
gun				
Wedges, wood, oak ..	18" x 12" x 2½"	2		
			For cutting muzzle. Making fast crab capstan to pickets. For passing from one skid to another when not ex- actly on equal level.	For 38-ton guns only.

List of Stores.

Section VI.

MOUNTING AND DISMOUNTING IN OPEN BATTERY.

List No. 4.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Gyns, complete, with tackle, triangle, with levers, wood trucks	18-feet, heavy	1	Lifting breech	As required.
Jacks, lifting, hydraulic, Tangye's	10 to 20 tons	1	..	
Planks, wood, { whole ..	10' x 17" x 3"	4	For moving guns and slide, &c.	
oak, moving { half ..	6' x 12" x 3"	4		
guns	4' x 12" x 3"	8		
Rollers, wood, sabicu.. ..	3' x 5"	6	For moving slide.	
Ropes, drag, heavy	6		
Scotches, wood, { large ..	1' x 6" x 6"	20		
elm { medium ..	9" x 5" x 4"	20		
{ small ..	6" x 4" x 2½"	20		
Selvagees	2		
Shackles, iron, lifting, complete	1	For raising the breech with a gyn	With 38-ton gun only.
Skids, wood { fir.	20' x 15" x 15"	3	Under chase	
	6' x 12" x 12"	12		
	4' x 12" x 12"	4		
	14' x 8" x 8"	2		
	11½' x 15' x 20"	1		
oak, bolted together for dismantling R.M.L.guns { 35 and 38-ton guns 12-in. and 11-in. guns, 25 tons 10-inch guns ..	11½' x 10" x 20"	1		
10' x 9" x 15"	1			
9-in., 3 feet	1	Round cascade		
6-in., 12½ feet	2	Securing oak beam to slide		
Slings, white { with thimbles rope, gun { without	2	Securing oak beam to slide	
Tackles, luff, tarred, 2½" rope—10 fathoms, with 1 single and 1 double 8-in. Admiralty blocks	..	2	Securing oak beam to slide	

MOUNTING AND DISMOUNTING IN "C" EMPLACEMENTS.

List No. 5A.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Gyns, complete, with tackle, triangle, with levers and wood trucks	18-feet, heavy	1	Raising breech	As required.
Jacks, lifting, hydraulic, Tangye's	10 to 20-tons	1	..	
Planks, wood, oak, moving heavy guns, half ..	6' x 12" x 3'	8		

(A. M.)

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Section VI.

List of Stores.

MOUNTING AND DISMOUNTING IN "C" EMPLACEMENTS—*contd.*

List No. 5A.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.	
Ropes, drag heavy .. ..	.. ..	6		
Scotches, wood, { large ..	1' x 6" x 6"	16			
elm { medium ..	9" x 5' x 4'	16			
.. .. { small ..	6" x 4" x 2½"	16			
Selvagees .. ..	..	2		
Shackles, iron, lifting, } complete }	..	1	For raising the breech with a gyn	With 38-ton guns only.	
<div> <div>Skids, wood {</div> <div> <div>fir.. .. . }</div> <div> <div>oak {</div> <div> <div>.. .. . }</div> <div> <div>bolted together for dismantling heavy R. M. L. guns</div> <div> <div>35 and 38-ton guns 12" & 11" guns, 25 tons 10" guns</div> <div> <div>11½' x 15' x 20"</div> <div>11½' x 10' x 20"</div> <div>10' x 9' x 15"</div> </div> </div> </div> </div> </div> </div></div>	6' x 12" x 12"	10	Supports.		
	14' x 8" x 8"	1	For "fid" in bore, with plank underneath, if necessary.		
	3' x 9' x 6"	4			
	3' x 6" x 3"	2			
		1	Under chase.		
		1			
		1			
	Slings, { with thimbles	9-in., 3 ft.	1	Round cascade	
	white rope { without ..	6-in., 12½ ft.	2	{ Securing oak beam to slide	
	Tackles, luff, tarred, 2½-in. rope, 10 fathoms, with 1 single and 1 double 8-inch Admiralty blocks	..	2	{ Securing oak beam to slide	

N.B.—For the Stores required for moving by sleigh, or parbuckling the gun on to the platform, *vide* Stores detailed in Lists 2 and 3.

MOUNTING AND DISMOUNTING BY BOX-BEAM IN "C" EMPLACEMENTS, OR IN CASEMATES WHERE THE HEIGHT OF THE CROWN OF THE ARCH IS ABOVE 12 FEET; SUCH AS HURST CASTLE.

List No. 5B.

STORES REQUIRED.

Apparatus, wood frame (Col. Inglis') No. 1.

The Stores in List 7A will also be required.

List of Stores.

Section VI.

MOUNTING AND DISMOUNTING IN CASEMATES.

List No. 6A.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Chain, iron, fathoms .. {	$\frac{3}{8}$ -inch	1	Short sling ..	} For beam.
	$\frac{3}{4}$ -inch	12	Lashing beam to cascable ..	
Jacks, lifting, hydraulic, Tangye's, with portable base	10 to 20-tons	2	..	According to weight of gun.
Levers, wood	14-feet	2		
Planks, wood, oak, moving guns, half	$6' \times 12'' \times 3''$	6		
Ropes, drag, heavy	$4' \times 12'' \times 3''$	4		
Selvagees .. .. .	..	6		
Skids, wood { oak {	fir.. .. .	22		
	.. .. .	16		
	.. .. .	4		
	.. .. .	2		
	.. .. .	4		
	bolted together for dismantling heavy R. M. L. guns, 35 and 38-ton guns, 11' & 12' guns, 25 tons	1	$11\frac{1}{2}' \times 15'' \times 20''$	
	.. .. .	2	$11\frac{1}{2}' \times 10'' \times 20''$	
	.. .. .	2	$10' \times 9'' \times 15''$	
	Slings, white rope, gun ..	2	6 in., $12\frac{1}{2}$ ft.	
	Tackles, gun, white, 3-in. rope, 16 fathoms, with 1 double and 1 treble 9-inch Admiralty blocks	2	..	

N.B.—When the breech is lowered by means of tackle, the following additional stores will be required :—

Crabs, iron, double-purchase, for hoisting heavy guns	2-tons	1	To raise breech.	
Lashings, 5 fathoms	$2\frac{1}{2}$ -inch	2	To secure crab.	
Ropes, gaskets, white, 3 fathoms	6-inch	1	To stopper fall.	
Tackles, gyn	18-feet, heavy	1	To raise breech.	

Section VI.

List of Stores.

**MOUNTING AND DISMOUNTING GUNS UP TO 25 TONS IN CASE-
MATES 12 FEET AND UNDER, WHEN SPECIAL TACKLE IS USED
AS PROPOSED BY CAPTAIN A. G. YEATMAN-BIGGS, R.A.***

List No. 6B.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Blocks, wood, Both-way's { treble { with special shackle single { with special shackle to swivel with special shackle	18-in., Mark III.	2	Breech ..	{ 1 for crown of arch. 1 for cable.
	12-in., Mark II.	4	Muzzle ..	{ 1 for crown of arch. 2 for muzzle straps.
	12-inch	1	Runner tackle, for breech.	
Cordage, white, hawser, 3-strand, for falls of tackles { 15 fathoms 12 fathoms (2 to a set) 56 fathoms	6 "	1	Breech tackle.	
	4 "	{ 1 1	Muzzle tackle. Runner tackle.	
Crabs, iron, double purchase, for hoisting heavy guns.	2-tons	3	{ 2 for muzzle 1 for breech	{ tackles
Jacks, hydraulic, Tangye's, to lift 20 tons. . . . .	..	1	..	
Lashings	2½-inch	6	Securing crabs.	
Ropes, gasket .. .	6 "	1	Stoppering falls	
	4 "	2		
Shackles, iron, for wire sling (2 to a set) ..	..	1	..	
Skids, wood, oak. . . .	3' x 9" x 6"	6	..	
Slings, wire rope, with thimbles	2' x 11' x 3"	1	For chase.	

* A description of the use of this tackle is given in Manual of Artillery Exercises, revised edition.

N.B.—Holdfasts will probably be required to secure the breech crab; the ring-bolts in casemates will probably be sufficient for muzzle crab.

**MOUNTING AND DISMOUNTING BY BOX-BEAM (SUSPENDED FROM
ROOF OF CASEMATE); SUCH AS SPIT BANK FORT.**

List No. 7A.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Bolts, bent, iron, wrought, with two spherical nuts, each	3' x 2"	2	For suspending gun to box-beam.	Or one 4½-in. parbuckling rope.
Box-beam, complete .. ..	..	1		
Cordage, fathoms	4½-inch	6	To support rear of carriage with two luff tackles	
Handspikes, common ..	7 feet	6		

List of Stores.

Section VI.

MOUNTING BY BOX-BEAM (SUSPENDED FROM CASEMATE)—*continued.*

STORES REQUIRED.

	No. required.	For what purpose.	Remarks.
	6	These jacks are required with on guns.	
	6		
	2	For connecting beam to roof.	
	3		
	8		
	8		
	12		
	2	For steadying jack.	
	2	For raising front of carriage.	
	2		
	2	For bottom nut of main screw.	

N.B.—Short lengths of $\frac{1}{2}$ -inch chain (about 4 fathoms each) will be found useful when hoisting the carriage by tackle made fast to the box-beam.

Only 38-ton guns are fitted with studs to the trunnions, for the loops of the box-beam.

MOUNTING AND DISMOUNTING HEAVY ORDNANCE IN LOW-ROOFED CASEMATES LESS THAN 9 FEET 6 INCHES IN HEIGHT.

List No. 7B.

STORES REQUIRED.

	No.
Screws, 3-inch, with spherical nuts.. .. .	3
Shackles, 4-inch, washer-plate and bent-bolt	3
Jacks, lifting, hydraulic, Tange's, with portable base, 30-tons ..	2
For bringing the gun into position, <i>vide</i> Lists 2 and 3, as required.	

Section VI.

List of Stores.

HEAVY SHEERS.

List No. 8.

STORES REQUIRED.

Name of Store.		For raising Guns of		Remarks.
		35 and 38 tons.	18 to 25 tons.	
Axes, pick, helved		4	4	
Blocks, wood	21-inch	4	..	For altering lead of main tackle and guy runner falls.
	Admiralty, iron-bound, snatch	2	4	For derrick and altering lead.
	18 "	..	2	For main tackle at foot of sheers.
	15 "	..	2	Back guy of derrick.
	Bothway's treble	8	..	4 for main tackles, 4 for guys*
	18 "	..	8	4 for main tackles, 4 for guy tackles.
Capstans, crab, complete		2	..	For hauling forward feet of sheers when raised.
Chains, iron, short link, 12 fthms.	with shackle and bolt and special thimble for the bight, large enough to take the hook of a 21-inch block	1 1/2-inch	2	..
	1 "	2	..	For leading blocks at holdfasts.
	with shackle and bolt	1 "	..	2 For holdfasts.
	with 5-in. rings at ends 1 1/2 "	..	2	For holdfasts.
Cordage	" " " "	4 "	..	For holdfasts, as required.
	hawser, 3-strand, 2 1/2-inch, fathoms	..	60	12 lashings of 5 fathoms each.
	yarn, spun, hemp, lbs.	6	5	
	or white, 1 1/2-inch fms.	80	80	For anti-twisters.
	7-inch	452	..	2 coils for main tackles.
	6 "	..	452	2 coils for guys.*
	6 "	113	..	Ditto ditto.
	4 1/2 "	..	113	Back guy of derrick.
	4 "	..	35†	Back guy of derrick.
	white, hawser, 3-strand, fathoms	4 "	169	Head lashing.
	4 "	169	169	Side guys of derrick.
	3 "	..	24	2 lashings for snatch blocks at foot of sheers.
Crabs, iron, double purchase, for hoisting heavy guns	3 "	..	6	Lashing leading blocks to foot of derrick.
	2 1/2 "	..	9	Head lashing of derrick.
	2 1/2 "	..	8	2 pieces of 4 fathoms each, for lashing blocks of tackles to derricks.
	5-ton	4	4	2 for main tackles
	2 "	..	4	2 for guys
				2 for main tackles
Drivers, pile, Swiss, complete		3	3	
Grease, lubricating, mineral lbs.		6	6	

* If rigged with two back guys provision must be made accordingly.

† Not required for sheers which have the head fitted with iron bolt wire guys, and hooks and chain for attaching main tackle.

List of Stores.

Section VI.

HEAVY SHEERS—continued.

List No. 8.

STORES REQUIRED.

Name of Store.	For raising Guns of		Remarks.
	35 and 38 tons.	18 to 25 tons.	
Mauls, wood, helved { common	6	6	} For driving pickets.
iron-hooped	6	6	
Planks, wood, moving guns, whole, { fir	20	8	} For placing under coils of rope and for holdfasts.
10' x 17' x 3' { oak	12	6	
Posts, picket, garrison { 8-feet	32	12	} For holdfasts.
{ 5 "	20	12	
	..	12	Holdfasts for foot tackles of derrick.
Ropes, { gasket, white { 7-inch	4	..	} For crabs.
	6 " .. ..	..
	2½-in., tarred 5 fms.	12	Lashing pickets, &c.
	lashings .. { 3 " white 10 "	8	Lashing blocks on der- rick.
	4½ " " 12 "	2	For lashing lower blocks of main tackles to spars.
	drag, heavy	6	General purposes.
{ wire, guy { 7-inch (in 30-feet lengths)	8	..	} For guys.
	5½-inch, fitted with shackles, in 30-feet lengths .. ..	..
Rollers, wood, elm, 6' x 10'	8	..	For moving spars and crab winches.
Belvages	12	12	General purposes.
Shovels, universal, halved	6	6	
† Skids, { fir, 6 feet x 12 inches square	20	12	Skidding spars, &c.
wood { oak, 14 feet x 12 inches square	2	2	For heavy holdfasts.
Slings, { 9-inch, 16 feet, with thimbles	..	14	Two for guy straps, two for main tackles.
white {			For securing capstans.
rope, gun { 6 " 12 " 6	2	..	For foot tackles.
	..	3	One for head of derrick, two for foot tackles.
Steps or shoes, wood, for { feet of sheers	2	2	For sheers.
{ foot of derrick	1	1	For derrick.
Tackles { gun, white 3-inch rope, 16 fathoms, 1 double and 1 treble 9-inch Admiralty blocks .. ..	..	2	} For foot tackles of der- rick.
	5-inch rope, 18 fathoms	4	
	gun { 3½ " 16 "	2	For foot tackles and moving feet of sheers.
		..	For foot tackles of der- rick.
	luff, tarred, 2½-inch rope, 10 fathoms, with 1 double and 1 single 8-inch Admiralty blocks	4	For foot tackles of sheers.
		4	Runners for derrick guys, &c.

* If steel wire guys are supplied, the size will be less.

† Short (Service) oak skidding, such as 6' x 9' x 3', &c., &c., as required.

--- ‡ Not required for sheers which have the head fitted with iron bolt wire guys, and hooks and chain for attaching main tackles.

Section VI.

List of Stores.

HEAVY SHEERS—*continued.*

List No. 8.

STORES REQUIRED.

Name of Store.	For raising Guns of		Remarks.
	35 and 38 tons.	18 to 25 tons.	
Thimbles, round, to take hook of 18-inch blocks .. .. .	..	4	*For use with guy straps (9") and main tackles.
Timber, sheers and derricks, spars for { 70 feet diameter, ins. ..	2	..	Sheer legs fitted with head bolt and chains for main tackles.
{ 60 feet mean diameter, 20 inches .. ..	..	2	Sheer legs.
{ 50 feet, about 15 inches	1	..	} For derricks.
{ 40 feet, 10 inches .. ..	..	1	
{ 30 feet, 10 inches	1	..	For securing across feet of sheers when moving them to the front.
Shackles, heavy .. .. .	..	4	Capable of taking 18' blocks at holdfasts.

* Not required for sheers which have the head fitted with iron bolt wire guys, and hooks and chain for attaching main tackles.

N.B.—The Stores required for the holdfasts must in a great measure depend on local circumstances.

Should it be required to heel sheers, when raising 18 to 38-ton guns, at an angle greater than 15° from the perpendicular, they should be rigged with two guys on the side which has to take the weight at extreme heel.

This detail only makes provision for one back and one fore guy, and if two are required, demands should be framed accordingly.

Gear for landing heavy ordnance in iron forts at Spithead and Breakwater Fort, &c., is special, and supplied where required. No other Stores will be required, except for removing the guns when landed, for which see List 2.

GEAR FOR MOUNTING AND DISMOUNTING 38-TON GUNS IN SMALL PORT CARRIAGES AT PLYMOUTH BREAKWATER FORT AND FORT CUNNINGHAM, BERMUDA.

List No. 9.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Bars, wrought-iron, with 2 plain holes, edges rounded, and { 2 cupped and coned holes	} 4' 10" × 9" × 5"	1	For suspending long screw bolts.	
{ 4 cupped and coned holes		1	For suspending the bent bolt that passes round cascable.	
Blocks, teak	1' 4" × 11" × 5"	1	For fitting inside the bent bolt on top of cascable.	

List of Stores.

Section VI.

GEAR FOR MOUNTING AND DISMOUNTING 38-TON GUNS IN SMALL
PORT CARRIAGES AT PLYMOUTH BREAKWATER FORT AND
FORT CUNNINGHAM, BERMUDA—*continued.*

List No. 9.

STORES REQUIRED.

Name of Store.	Size.	No. required.	For what purpose.	Remarks.
Bolts { bent {	with 4 hexagonal nuts }	1' 4½" × 2"	1	For connecting top bar to rear loop bolt in roof of casemate.
	with 2 spherical nuts	2' 5" × 2"	1	To fit round the cascable.
	straight, with 2 spherical nuts and 1 pin }	5' 3" × 2"	2	For connecting upper and lower bars.
Frames, wrought-iron	2' × 2' × 1' 6"	2	For steadying the hydraulic jacks.	
Pads, brass;	{ 3½" × 3½" × ½" average }	1	To ensure a better bearing between the roof bolt and the bent bolt.	

GEAR FOR LANDING HEAVY ORDNANCE IN IRON-CLAD FORTS
(SUCH AS AT SPITHEAD AND PLYMOUTH BREAKWATER).

List No. 10.

This gear is special and supplied where required.

No other stores will be required, except for removing the guns when landed, for which *see* List No. 2.

GEAR FOR LANDING CARRIAGES, PLATFORMS, &c., AT SEA FORTS.

List No. 11.

This gear is special and supplied where required.

The only stores required with it are one or two sets of heavy tackle, 18-in. blocks, 6-in. fall.

Gun Sleighs.

PART IX.—GUN SLEIGHS.

GENERAL OBSERVATIONS.

In carrying out the arming of fortresses with heavy guns, a great deal of most important work is done by employing gun sleighs, by means of which guns of the heaviest calibre are conveyed up and down steep slopes, through sallyports, across draw-bridges, into casemates, and confined situations, where it would be difficult to effect their transport by other means.

This being the case, the fullest information has, in the following pages, been afforded on the subject.

Temporary sleighs have not, as a rule, been constructed for heavier guns than the 9-in. of 12 tons, but there is no reason why the heavier natures should not be transported by this means, provided some oak skids for side pieces and transoms can be procured, in proof of which an example may be cited where a number of 18-ton guns had to be conveyed over considerable distances, and broken and hilly ground. No permanent sleigh was available, but three oak skids 14' x 9" x 9" were procured; two were used for the side pieces, and the third sawn in two for the transoms, and with these a temporary sleigh was made, by means of which fifteen 10-inch guns were moved into position without the smallest difficulty or injury to material.

Sleighs permanently constructed are issued for moving heavy guns up to 38 tons. They are made of African oak, and have the ends and lower edges of the side pieces iron bound. They are 18 feet long by 5 feet broad, and weigh about 3 tons.

The O. P. sleigh is fitted with two end and one centre transom, the latter being hollowed out. The side pieces are 12 inches deep. It was constructed for weights up to 25 tons. The N.P. sleigh has two end and two intermediate transoms; these being flush with the upper surface of the side pieces, guns can be readily rolled on and off the sleigh, as described at page 459. The side pieces are 15 inches deep. It will take guns up to 38 tons.

Iron-bound rollers of African oak, 7 or 8 feet long, and 12 inches in diameter, are issued for use with these sleighs.

Heavy guns have often to be placed in positions where wheel transport cannot be employed for their conveyance, either on account of the great weight of the gun, the difficulties of the road, or the confined space in which the work has to be carried out; under these circumstances they are generally moved on a sleigh, which

Gun Sleighs.

is not only more rapid, but is less laborious and destructive to material than parbuckling, and enables the gun to be taken through narrow passages and placed in any desired position with facility.

No rules can be given as to the kind of roadway that should be laid down for a sleigh, as it entirely depends on the weight to be moved, and the nature of the ground to be traversed; but planks or skids, or a combination of the two, will generally be found to suffice.

When it is required to make a gradual change of direction, it may be effected by altering the position of the rollers. The leading roller should be "cut" round till it lies at right angles to the desired line of direction, and the rear roller the reverse way.

With comparatively light guns, rollers may be "cut" by striking their ends with mauls; the further they are from the centre of gravity, the easier it is to move them, and *vice versa*. With very heavy guns it will be generally necessary, to enable rollers to be re-adjusted, to raise one end of the sleigh with jacks or levers.

If done by jacks, care should be taken to work them up and ease them down simultaneously, so as to avoid straining the sleigh: if by levers, they should, for the same reason, be borne down and eased up at the same time.

Should it be necessary to turn square to a flank, it can be easily effected by slewing on a centre roller.

The sleigh being balanced on the centre, the end rollers are removed, and replaced by skids or planks of rather less height, so as not to bear against the sleigh but to prevent its dipping at either end. The sleigh is slewed by tackles applied in opposite directions at its extremities. If the centre roller comes round with it, so much the better, if not it must be readjusted when necessary.

With the heavier natures of guns, it is a good plan to divide the side pieces of the sleigh into three equal parts, make a chalk mark at each, and apply the rollers so that when one is just taking in front, one going clear in rear, the two intermediate may be at the chalk marks.

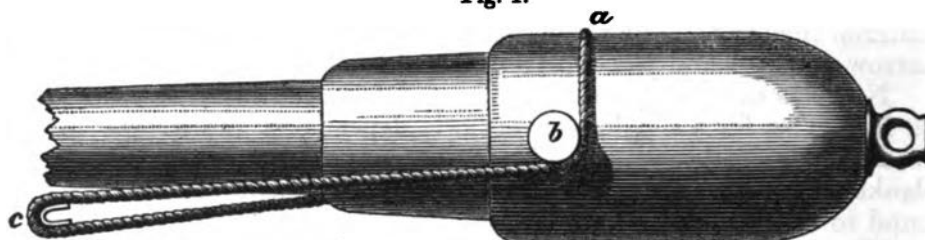
The greater the diameter of the rollers, the easier will the sleigh travel.

It is useful to bear in mind that a weight travelling on rollers progresses at exactly twice the rate the rollers do.

When space is restricted, either as regards width of gangway or height, it is sometimes necessary to use 6-foot elm rollers instead of the 7' or 8' x 12" African oak; in these cases if moving a very heavy gun, it is advisable to keep one or two additional rollers under the sleigh, and so distribute the pressure over a large number. The rope or tackle used to move the gun and sleigh should be attached to the gun, either to the cascable or to a sling applied as shown, Fig. 1.

Gun Sleighs.

Fig. 1.



A bight of the sling is placed on top of the gun at *a*, thence it is led under each trunnion at *b* (to front or rear as required), and the tackle is hooked into the other bight at *c*, which should be fitted with a thimble to save the sling from injury.

With the smaller natures when a parbuckle rope is used to move the gun and sleigh it may, for travelling breech foremost, be secured to the cascable, and for moving muzzle foremost, be made fast in the same manner, the end to be hauled on being passed to the front and a half hitch taken round the chase.

The motive power required to move guns on sleighs on the level may be stated generally as follows:—

Guns under 5 tons, by manual labour.

Guns of 5 or 7 tons, one $4\frac{1}{2}$ parbuckle rope taken in by a crab capstan.

Guns of 12 and 18 tons. A tackle giving a power of 2 to 1 worked by a crab capstan. For this purpose, one 12-inch single or snatch block is attached to the gun and rove with a fall of 4-inch rope, one end of the fall is made fast at the capstan holdfast and the other end taken in by the windlass.

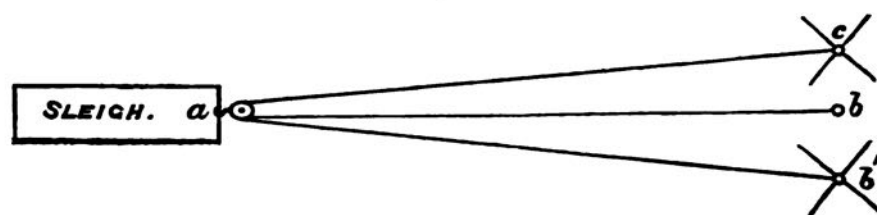
Guns of 25 tons. A tackle giving a power of 3 or 4 to 1 worked in like manner.

6-inch falls and 18-inch blocks may be used if preferred, but a crab capstan cannot exert a greater strain than the safe working strain of a 4-inch rope, and the lighter tackle is handier.

When moving a gun on a sleigh with capstan and tackle, if it is desirable to travel faster it is well to make use of a second capstan to take in what was the standing end of the fall, if there are men enough to man the two capstans.

For example in Fig 2.

Fig. 2.



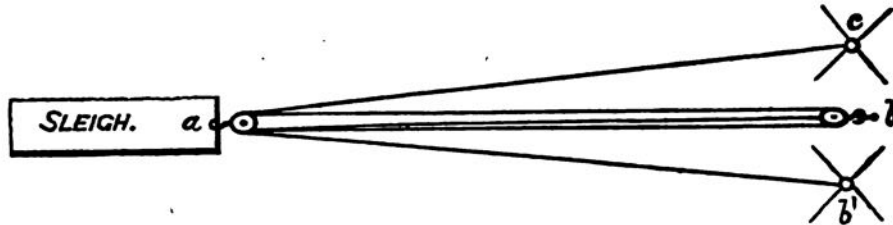
a is a single block attached to a 12-ton gun on a sleigh, the standing end of the fall is made fast to a holdfast at *b*, and the running end is taken by the crab capstan at *c*.

Gun Sleighs.

To travel at twice the rate, establish a crab capstan at b' transfer the standing end of the fall from the holdfast at b to its windlass, and heave round on both capstans at once.

Another example Fig 3.

Fig. 3.



a is a double block attached to a 25-ton gun on a sleigh, the standing end of the fall is secured to the single block of the tackle at b , and the running end taken in by the crab capstan at c . To travel at twice the rate establish a crab capstan at b' , transfer the standing end of the fall from the single block at b to its windlass, and walk round on both capstans at once.

The double block becomes, as it were, two single blocks, giving each a power of 2 to 1, whilst the number of men working, and the rate of progression, are doubled, and the friction of the fall through the single block at " b " is got rid of.

When heavy guns have to be taken on sleighs up or down steep inclines, it is well to employ two tackles for the motive power, each worked by an iron crab.

This plan possesses the following advantages:

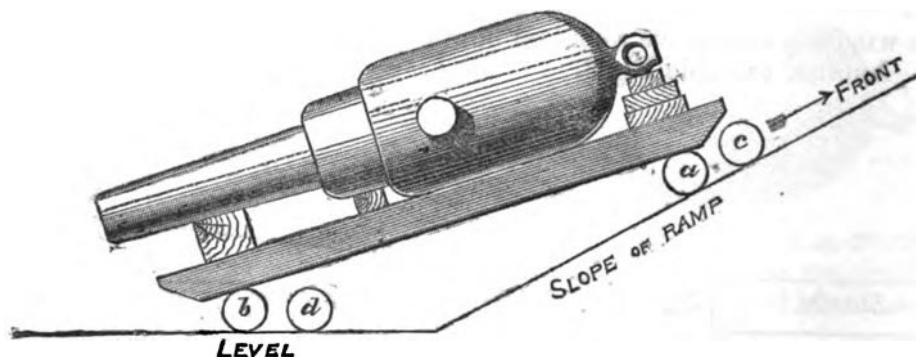
1. One tackle acts as a check if anything goes wrong with the other.
2. One iron crab holds on whilst the other shifts the fall, thus saving the time lost by stoppering.
3. Two tackles of moderate power instead of one of, say, double the power, enable the weight to be moved at twice the rate, at the same time that either tackle is amply strong enough to hold the sleigh at rest on the slope with rollers scotched up (and they always should be followed up with scotches).
4. Iron crabs are more powerful than crab capstans, and possess the advantage of pawls, which give additional security.

If the roadway is wet or slippery, it should be sanded to ensure the rollers and scotches biting.

When travelling from the level on to a slope, the following points have to be attended to; a glance at Fig. 4 will show that as the sleigh passes from the level on to the slope, only those rollers which are under its extremities at a and b can be kept in bearing; the gun, therefore, should be well supported with skidding under both cascable and chase, so as to avoid straining the sleigh or breaking its back.

Gun Sleighs.

Fig. 4.



Again, if the front roller at *a* is allowed to travel too far back before another roller is applied under the curve of the sleigh in front, the front of the sleigh descending towards the surface of the ramp, renders it impossible to apply another roller, and the work comes to a standstill; it is necessary, therefore, to have another roller at *c* ready to apply as soon as the roller at *a* has travelled a few inches to the rear.

As soon as the rear roller at *b* comes to the commencement of the curve of the sleigh in rear, it must be followed up within a few inches by another roller at *d* ready to take its place, otherwise the rear of the sleigh would drop, and infallibly strike the ground with great force and do mischief.

With these precautions, the sleigh may, without risk, be moved fairly on to the slope, after which the rollers are applied in the usual manner.

On arriving at the top, the sleigh is simply allowed to dip on to a roller placed on the level to receive its front; this it will do as its centre of gravity passes beyond the intersection of the slope of the ramp and the level at top.

As regards tackle power necessary, that must depend on the incline and weight to be moved, suffice it to say, that, with two tackles, each consisting of one treble and one double 18-inch Bothway block rove with a 6-inch fall and worked by iron crab, double purchase, 25 or 38-ton guns may be taken up any slope likely to be encountered.

Lowering down a slope is the converse of the foregoing.

Guns should, as a rule, be placed on sleighs with their centre of gravity over the centre of the sleigh.

The weight should be distributed as much as possible, to avoid straining the material: for instance, on a permanent sleigh, the gun should be supported by skidding under both cascable and chase, in addition to the intermediate points of bearing and on a temporary sleigh there should be four points of bearing, viz., both trunnions and front and rear transoms.

The tackle or ropes used for hauling or as checks, should be attached to the gun and not to the sleigh.

Gun Sleighs.

For transom lashings for temporary sleighs, it will be found that $1\frac{1}{2}$ -inch rope affords ample strength, and is not only much more easily and rapidly put on than a heavier lashing, such as $2\frac{1}{2}$ -inch rope, but can be got much tauter, and offers less resistance to the rollers.

Each lashing should be from 8 to 10 fathoms in length, according to the size of the timber employed: two or more pieces may be joined together if issued in short lengths.

TEMPORARY SLEIGH FOR 64-PR. R.M.L. CONVERTED GUN AND OTHERS OF APPROXIMATELY THE SAME WEIGHT.

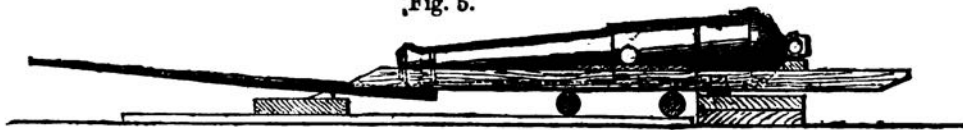
Stores required.

Handspikes, common, 6-foot (general purposes)	..	8
Lashings, $1\frac{1}{2}$ -inch, 3 fathoms each (securing transoms)	8	
Lever, 12-foot (raising muzzle)	.. .. .	1
Planks, fir, whole, $10' \times 17'' \times 3''$ (roadway)	.. .. .	4
Prisms, elm (support for breech)	.. .. .	1
Rollers, ground, elm, $6' \times 10''$ (moving sleigh)	.. .. .	3
Ropes, drag, heavy (moving sleigh)	.. .. .	2
Scotches, of sorts (general purposes)	.. .. .	20
Skids, fir, $14' \times 8'' \times 8''$ (side pieces)	.. .. .	2
„ „ $4' \times 12'' \times 12''$ (skidding gun, &c.)	.. .. .	2
„ oak, $5' \times 6'' \times 5''$ (transoms)	.. .. .	2
„ „ $3' \times 9'' \times 6''$	} (skidding gun, &c., &c.) ..	{ 6
„ „ $3' \times 6'' \times 6''$		
„ „ $3' \times 6'' \times 3''$		
„ „ $3' \times 4'' \times 4''$		

TO BUILD THE SLEIGH ROUND THE GUN.

The gun is skidded, vent uppermost, and trunnions horizontal, as shown in Fig. 5, the breech supported well back, on a prism laid across four $6'' \times 9''$ s on their flat, arranged fore and aft so as not to interfere with the placing the side pieces of the sleigh: for the latter fir skids $14' \times 8'' \times 8''$ are suitable.

Fig. 5.



The muzzle is raised with a lever, muzzle skidding cleared away, two planks for roadway placed parallel to the axis of the gun up to the breech skidding, two ground rollers over them, one in front and one in rear of the centre of gravity of the gun; the side pieces of the sleigh are arranged under the trunnions on top of the rollers, with their centres opposite to the centre of gravity of the gun, the

Gun Sleighs.

bevels at the end which will be foremost in travelling. The weight of the gun is distributed by placing a flat 3-inch piece under each trunnion on to which the gun is lowered. The muzzle being borne down and breech skidding removed, the rear transom (either 3 feet or 5 feet in length) is arranged under the cascable and secured with square lashing to the side pieces; instead of a front transom, a drag rope applied as a figure of eight lashing, secures the chase to both side pieces.

For the 80-pr. R.M.L. converted gun and others of approximate weight, a front as well as a rear transom may be used in constructing the sleigh, in which case it will be necessary to skid the gun somewhat higher under the trunnions to allow room for the front transom to be placed.

If intended to travel far, and especially if much change of direction may be looked for, luff tackles, or light gun tackles, may, with advantage, be applied as described for 9-inch, page 634, to keep the sleigh rectangular and the gun from shifting its position on the sleigh.

Dismantling is the exact converse of building the sleigh.

TEMPORARY SLEIGH FOR 7-INCH R.M.L. GUN.

The construction of a temporary sleigh for a 7-inch R.M.L. gun of 7 tons, is almost precisely the same as that described for the 9-inch gun.

The following points of difference may, however, be noted.

In skidding up under the breech, preparatory to building the sleigh round the gun, it will probably suffice to have only twelve, instead of fifteen inches of short oak skidding under the ends of the prism.

Under each trunnion there should be an oak skid 5' x 6" x 5" on its flat, with a flat 3-inch piece on top. Four instead of three oak skids 5' x 6" x 5" will therefore be required, two are used for the transoms, that for the front transom being placed on its flat, and the one under the cascable on its edge.

A 4½-inch parbuckle rope may be substituted for the 6-inch.

For moving, changing direction, &c., &c., *vide* instructions given under the head of "Permanent Sleighs."

TEMPORARY SLEIGH FOR 9-INCH R.M.L. GUN OF 12 TONS.

To construct a temporary sleigh for a 9-inch R.M.L. gun of 12 tons, the following stores are required:—

Chalk, pieces	1	Marking sleigh.
Jacks, lifting, hydraulic, 12-tons	1	Raising gun.
lashings, 1½-inch, 3 fms. each ..	12	Securing transoms.
Mallets, wood, small	4	Hammering lashings.
Mauls	2	Cutting rollers.
Planks, fir, whole, 10' x 17" x 3"	4	Roadway.

Gun Sleighs.

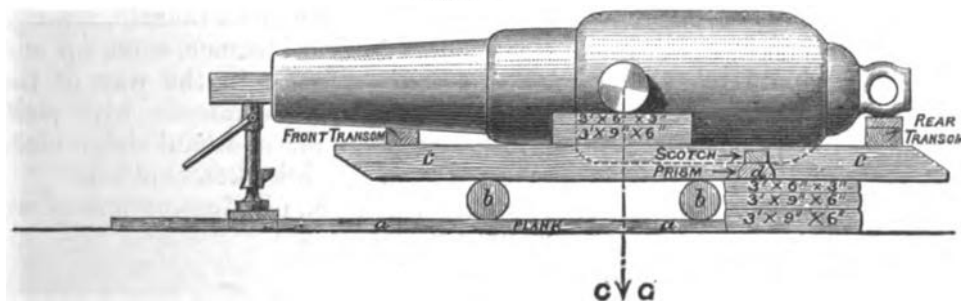
Prism	1	Support for breech.
Rollers, ground, elm, 6' x 10" ..	3	Moving sleigh.
Ropes, drag, heavy	2	General purposes.
„ parbuckle, 6-inch	1	Making fast to gun.
Scotches, of sorts	20	For scotching up.
Selvagees	4	General purposes.
Skids, fir, 14' x 8" x 8"	2	For side pieces.
„ „ 6' x 12" x 12"	2	Skidding gun.
„ oak, 5' x 6" x 5"	3	Two for transoms, one for skid in bore.
„ „ 3' x 9" x 6"	8	Skidding gun, &c.
„ „ 3' x 6" x 3"	4	„ „
Tackles, gun, heavy, complete ..	2	Securing gun on sleigh.
Thimbles, iron, circular	1	Securing in parbuckle rope.
Wedges, oak, small	20	Tautening lashings.
Yarn, spun, lbs.. ..	1	General purposes.

The gun is skidded with trunnions horizontal. As the gun sits best on the sleigh with about 9 inches of short oak skidding on top of the side pieces under each trunnion, this will determine the height at which it should be skidded in order to build the sleigh round it; the rule being to place the centre of gravity as low as possible provided the lower surface of the breech coil rides clear of the rollers, and that there is room to place the front transom.

The gun is now raised with the jack until the breech coil rests on 20 inches of skidding.

To enable the sleigh to be built round the gun, the after part of the breech coil should be supported and scotched up on a prism *d* placed across two piles of short oak skidding *each* consisting of two 6" x 9" on their flat with a flat 3-inch piece on top. (Fig. 6.)

Fig. 6.



The muzzle being now raised with a jack, the muzzle skidding is removed, and a long fir plank, *a a*, placed on the ground parallel to the axis of the gun and perpendicularly under each trunnion. Across these planks, the two ground rollers *b b*, are placed, one in front and one in rear of the centre of gravity of the gun, and scotched up, and over these again the side pieces, *c c*, with their

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Gun Sleighs.

centres under the axis of the trunnions, and their bevels according as it is intended to move the gun breech or muzzle foremost. In Fig. 6 they are placed for moving muzzle foremost. Under each trunnion is placed a 6'' x 9'' on its flat with a flat 3-inch piece over it. The jack is now eased down until the trunnions bear on these.

By bearing down the muzzle, the breech skidding can be cleared away and the breech transom, which consists of an oak skid 5' x 6'' x 5'' with a flat 3-inch piece over it, be placed in position; the muzzle is then allowed to come up and the muzzle transom (oak 5' x 6'' x 5'' on its flat) placed and mauled back as far as it will go, or until it is well in bearing under the chase.

The transoms are now secured with square lashings to the side pieces.

Wedges may be used to tauten up the lashings, though if they are well put on, the wedges are hardly necessary.

Slewing or cutting the rollers to change direction is apt to cause a temporary sleigh to lose its rectangular form, which strains it greatly, as the rollers neither "take" nor go clear from, both side pieces at once.

To guard against this and keep the gun from shifting its position on the sleigh, side tackles as follows may be made fast.

For travelling muzzle foremost: Take two heavy gun tackles, and make fast their treble blocks to a fid in the bore by means of a selvagee, and their double blocks in like manner to the extremities of the rear transom. Heave in on both tackles at the same time, and make fast the falls round the rear transom. The tauter the tackles, the better the sleigh keeps its form.

For travelling breech foremost. The treble blocks are made fast to the cascable and the double blocks to the extremities of the front transom, otherwise the same as before described.

The following is an easy method of dismantling the sleigh.

Cast off side tackles and front transom lashings, maul out front transom (hitting it towards the muzzle) bear down muzzle, arrange prism and skidding under breech, as in first instance, come up and scotch up breech. Should the rear roller be in the way of the skidding, its position must be altered. Raise muzzle with jack, remove short oak skids from under trunnions and haul sleigh clear away to the rear from under the gun, which is then skidded.

For moving, change of direction, &c., &c., *vide* instructions given under the head of "Permanent Sleighs."

TEMPORARY SLEIGHS FOR 18-TON GUNS.

A short account of what has been successfully carried out in transporting guns of this nature on "Temporary Sleighs," will be found under "General Observations," page 626. The mode of construction &c., is similar in principle to 9-inch of 12 tons.

Gun Sleighs.

TEMPORARY SLEIGHS FOR 25-TON GUNS.

There is no reason that 25-ton guns should not be moved on temporary sleighs if occasion demand it, but of course it would be necessary to provide oak timber for the side pieces and transoms of strength in proportion to the weight.

Oak timbers 15' in length and 12" \times 12" in section would probably prove suitable for the side pieces, and pieces of from 9 to 12 inches square in section for the transoms. When particular operations demand stores of special type they may often be procured from the R.E. or Naval Authorities, failing this, authority to purchase must be obtained.

In every case the principles of construction are as for 9-inch of 12 tons, and the moving, slewing, changing direction, &c., the same as described under "Permanent Sleighs."

WOODEN TRAVERSING PLATFORM USED AS A SLEIGH.

Wooden Traversing Platforms, if fitted with extra transoms (flush), make excellent gun sleighs, and have been largely employed as such at out stations.

TEMPORARY SLEIGH FOR 9-INCH R.M.L. GUN WITH TRUNNIONS VERTICAL.

Instances may occur when a heavy gun has to be taken through a passage too narrow to allow of its transit on a sleigh constructed in the usual manner, i.e., with the trunnions of the gun horizontal: in such cases the gun may be moved with the trunnions vertical and the mode of procedure would be as follows, taking a 9-inch gun of 12 tons as an example.

The trunnions are slewed till vertical.

To raise the gun, two 18-foot gins will be found most convenient, but should their employment not be practicable, recourse must be had to the method described at page 633, though it will probably be necessary to have about six inches more oak skidding under the ends of the prism.

The gun being raised and the muzzle skidding cleared away, two planks for the ground rollers are launched under the gun up to the breech skidding, about one foot apart in the clear, on these are placed two groundrollers 3' \times 6," one close to the breech skidding in rear of the centre of gravity of the gun, the other under the chase. On these again are placed two fir skids 14' \times 8" \times 8", with their centres opposite the axis of the trunnions, their bevels according as it may be desired to travel breech or muzzle foremost.

Oak skidding 3 feet in length is then placed on and across the
(A. M.)

Gun Sleighs.

fir skids, under the chase over the front roller; two 6'' x 9''s on their flat, side by side under the chase will probably answer well. The jack is then eased down till the chase bears on these skids, on which it is scotched up.

The gun is now supported by the prism and skidding under the breech, and the cross skids, or transoms, under the chase. To clear away the breech skidding and substitute a rear transom arranged under the cascable it will probably be found most convenient, if neither gyn or overhead tackle can be employed, to lash a short stout beam or skid to the cascable, apply a jack under each end, raise the breech (the front roller being scotched up), clear away the breech skidding, place about 15 inches of short oak skidding as a rear transom under the cascable, across and on top of the side pieces, and lower the jacks till the cascable bears on them. Just before it takes its bearing it is a good plan, in order to distribute the pressure, to jam in 3 or 4 medium scotches over the side pieces and under the breech coil on either side.

The mark or pattern of the gun will determine the exact thickness of oak skidding required under chase and cascable.

The points to be borne in mind are :—

1st. To keep the centre of gravity of the gun as low as possible to secure the maximum of stability.

2nd. To skid the gun sufficiently high on the sleigh for the lower trunnion to clear the rollers.

3rd. The width of the sleigh should never be *less* than that of the breech coil, so that a needless sacrifice of stability may be avoided.

The fir side pieces are now lashed together, front and rear, to keep them from opening out, and the cross oak skids or transoms may also be lashed to them.

When the gun is lifted clean up by means of gyns or overhead tackles, the operation is simplified, as in that case the gun is at once lowered on to the sleigh, the transoms, front and rear, being ready placed to receive the chase and cascable.

Dismantling the sleigh is the converse of building it.

The same principles of construction &c., hold good for 7-inch or other heavy guns.

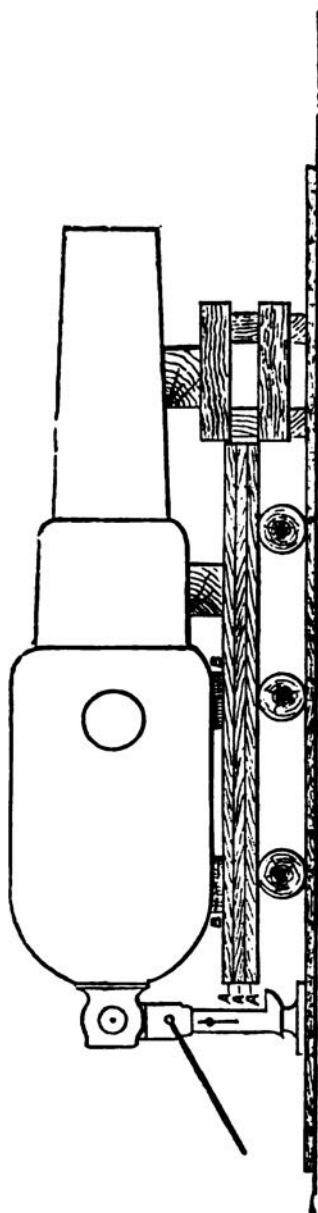
Gun Sleighs.

PLANK SLEIGH.

A temporary sleigh for guns from 7 to 18 tons may be readily constructed in the following manner.

The gun should be skidded as shown in Fig. 7, with the axes of gun and trunnions horizontal, the lower surface of the breech coil being about 25 inches above the ground (if a 3-inch plank roadway is to be used, under 10-inch rollers as shown in the diagram).

Fig. 7.



Gun Sleighs.

The distance between the jack under the cascable, and the supporting skidding under the chase, must be such as to admit of the three layers of oak planks (A, A, A), $10' \times 17'' \times 3''$, being placed, fore and aft, under the gun, and resting on the ground rollers.

The 10-foot oak planks are placed two and two side by side, with their inner edges touching, and on top of them are placed two 4-foot oak planks B, B, under the breech coil, and a $6'' \times 9''$ oak skid under the short coil, on to which the gun is lowered and scotched up.

Two layers of oak planks are sufficient for a 7-ton gun.

Constructed as above described, the sleigh will be found to answer well for moving guns over hard level roadways, but, should much change of direction be required, it is advisable to lash the long planks together, in three or four places, with $1\frac{1}{2}$ -inch lashings, and to tauten up the lashings by driving in wedges under the returns on the upper surface of the planks.

Should no oak planks be procurable, fir planks $10' \times 17'' \times 3''$ may be used instead, but will not stand much wear.

The advantages possessed by a sleigh of this nature are:—

1. The ease with which it is constructed, or dismantled.
 2. The small amount of material required for its construction.
 3. Its shortness and narrowness offer special facilities for moving guns in confined spaces.
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Sheers and Derricks.

PART X.—SHEERS AND DERRICKS.

SHEERS.

There are three different descriptions of sheers, viz :—

1. Sheers.
2. Lever sheers.
3. Gyn sheers, with or without lengthened prypole.

The first is used where there is plenty of space for erecting and working them, and where great lift is required.

Whilst they have the advantage of great strength and lift, those intended for very heavy weights require not only very heavy spars but also very heavy stores.

The second where a back guy only can be fixed, and where spars of insufficient size for ordinary sheers are alone available.

The third where the weight to be taken is under that for which the gyn is constructed.

At times there is much difficulty in finding suitable holdfasts, without which sheers cannot be erected.

Spars for temporary sheers are generally of wood in one piece, rounded and dressed, the butt ends being made so as to fit into shoes; wrought iron or steel is generally used for the spars of permanent sheers.

The size of spars and material must depend on the nature of the operation to be performed; the following will serve as a guide :—

Class of Sheers.	Weight to be raised.	Spars.	
		Length.	Mean Diameter.
Light	3 to 5 tons	30 to 40 feet	11 to 13 inches
Medium	5 „ 12 „	40 „ 50 „	13 „ 16 „
Heavy	12 „ 25 „	50 „ 60 „	16 „ 20 „
Ditto	35 „ 38 „	60 „ 70 „	About 24 „

Sheers and Derricks.

The mean diameter of the spars should be in proportion to their length, which will, to a great extent, be regulated by the distance from the feet at which it is required to pick up or lower the weight. With short spars a greater angle of heel will be necessary, and consequently there will be a proportionately heavier strain on the back guy, and thrust on the spars. For these reasons the longest spars are, as a rule, to be preferred, provided they have sufficient diameter. Very long spars, if too slender, have an inclination to "buckle" or bend.

Previous to the erection of sheers for any definite purpose, suitable spars and cordage should be selected, all being thoroughly examined to see that they are sound and in good condition.

It is essential, especially if the spars are to be given extreme heel, to ascertain first, what angle of heel will be necessary to enable the weight to be picked up or lowered at the required distance from the feet, and then to determine by construction in the manner described (at page 429), the strains on the guys, thrust on the spars, &c., as from the knowledge thus obtained a proper selection of gear can be made, and the mode of rigging the spars be, if necessary, modified.

For guy tackles likely to be wetted with salt water tarred cordage should be used.

All sheers, both light and heavy, are erected on precisely the same principles, in some the spars are connected with a bolt through the head instead of being lashed.

The shoes for the feet should rest on a solid foundation and be on the same level; they should be sunk flush with the ground, lashed, or otherwise secured to prevent their moving.

As a rule the heel given to sheers should not exceed 20° , and the strain on the back guy is then about one-half of the entire weight, *i.e.*, gun spars, main tackle, &c.

When sheers have to be heeled to angles exceeding 20° , which is sometimes necessary in disembarking guns from vessels with considerable breadth of beam, they should either be rigged with one back guy of extra power or with two back guys of the ordinary description: as an exception to this, the instance may be quoted in which the back guy holdfast is situated at a level considerably above that of the feet of the spars, when from the guy acting at a more advantageous angle, greater heel may be given without throwing undue strain on the gear.

In heeling sheers, before taking the weight, due allowance should be made for the extra heel that will be obtained from the stretching of ropes in taking the weight; 7 or 8 degrees must always be allowed for this.

Sheers and Derricks.

Great care should be taken in raising, working, and lowering sheers that no one is under any spar or weight, or standing in the bight of a rope, or where, if a block was to fly or rope part, he would be in danger.

The foot ropes or tackles should be so arranged that they can be held on or eased off without any No. exposing himself to danger from the spars in the event of their slipping.

The crabs or capstans should be placed sufficiently to the right or left that all the Nos. working them may be clear of the spars when they are on the ground, by at least a spar's length.

When rigging sheers every precaution should be taken to guard against twist in the main tackles and guys.

The officer in charge should always place himself so that he can watch as far as possible the whole working of the sheers, particularly the heel.

One No. should invariably be left at the holdfasts on which there is a strain, to see that everything is secure.

It must be remembered that long guys and tackles by their own weight exert considerable force on the head of sheers. On no account therefore should sheers be raised without having both guys secure, so that by no possibility could the spars be heeled over the wrong way.

The guys of sheers left standing should be somewhat slack to allow for the cordage shrinking from wet.

TO PREPARE SHEERS.

The strength of the detachment required for preparing and raising sheers depends on the size of the spars and nature of the ground, or description of holdfasts to be employed.

The following is the method of telling off the detachment. As many N.C. officers or intelligent gunners as may be necessary to take charge of each section of the work to be undertaken are fallen out and numbered from right to left, the remaining Nos. are divided into squads of the strength required for the performance of the work of each section. The sections form in column and are numbered by the Nos. already detailed, thus:—

"Tell off Sections."—The Nos. in charge number their sections from the front, thus, that of the first section, *Section No. 1*, the second, *Section No. 2*, and so on.

The following are the stations of the several sections, the No. 1 of each section is responsible for the duties it has to perform.

 Sheers and Derricks.

GENERAL DUTIES.

No. 1	Section.	Head of sheers.
No. 2	"	Feet of sheers.
No. 3	"	Fore guy.
No. 4	"	Back guy.
No. 5	"	Main tackle, leading block, sling and steadying ropes.
No. 6	"	Capstan or other power used for raising the weight.

The strength of the sections will consequently vary.

The case of light sheers erected on level ground will serve as an example; the strength of the sections in this case might be:—

No. 1	..	..	..	..	4
No. 2	..	..	..	..	5
No. 3	..	..	..	..	3
No. 4	..	..	..	..	5
No. 5	..	..	..	..	3
No. 6	..	..	..	..	4

To give the requisite lateral stability, the splay, or distance between the feet, measured from centre to centre, is made one third of the length of the spars from butt to crutch, by the term "crutch" being meant the spot where the spars cross, when connected by means of lashing, or the point of junction through the medium of a head bolt, when the latter method of connecting the spars is followed.

The positions for the feet and guy holdfasts must first be marked out.

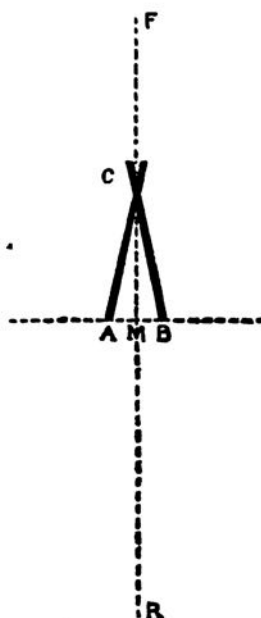
The position of the guy holdfasts should be such as to enable the guys to control the motion of the head of the sheers without subjecting either spars, guys, or holdfasts to undue strain. If they are placed very near the feet the strains both on the guy supporting the head, and on its holdfast, and the thrust on the spars (when at extreme heel with a suspended weight) become excessive, from the disadvantageous angle at which the guy acts with reference to the spars; furthermore, from the fact of the strain on the holdfast acting so much in an *upward* direction, it would, under ordinary conditions, be especially liable to draw or displace it. If, on the other hand, the guy holdfasts be placed very far from the feet, the guys are of necessity of unwieldy length and weight.

The following rules should therefore be adhered to as closely as possible.

Fig. 1 represents, in plan, a pair of sheers about to be erected on a level plain.

Sheers and Derricks.

Fig. 1.



AC, CB, are the legs of the sheers (to the crutch).

F, the fore guy holdfast.

R, the back guy holdfast.

M, the centre of line AB at right angles to FR.

Then make $AC = CB$.

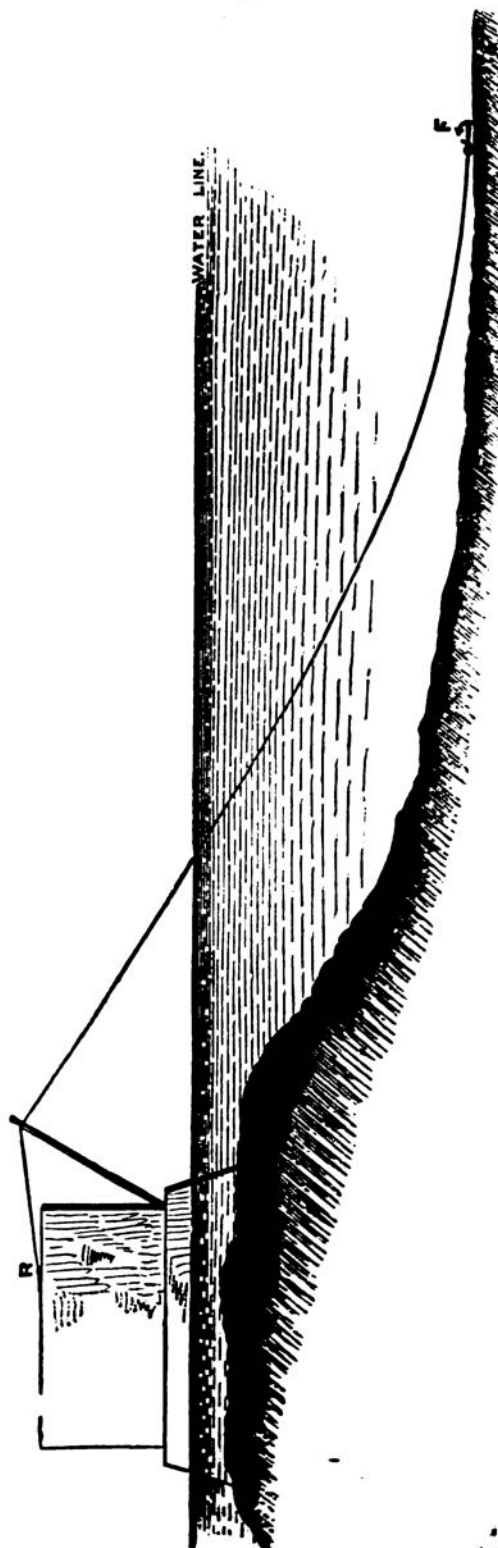
The splay $AB = \frac{1}{2} AC$.

MF or MR, or distance to holdfasts $= 2 AC$.

When the guy holdfasts are established on either a higher or a lower level than the feet of the spars, this rule will, in pursuance of the principles previously enunciated, require modification; for instance in Fig. 2, representing in elevation a pair of sheers which have been raised, we have the back guy holdfast R, on the top of a tower, considerably above the feet of the spars, while the fore guy holdfast F, lies at the bottom of the sea far beneath them; in this case the former may be established but a very short horizontal distance from the feet, whereas the latter will require to be much more than twice the length of the spars, measured horizontally, from the same spot.

Sheers and Derricks.

Fig. 2.



Sheers and Derricks.

In every case it is most essential that both fore and back guy holdfasts be situated *in the same vertical plane* with the head of the sheers, or instability will result.

When blocks are hooked into the bight of a chain at a holdfast, a suitable thimble should always be employed, so as to avoid throwing a cross-breaking strain on the link where the hook bears, and so subjecting the chain to a kind of *strain* it is not calculated to resist. When the chain is used on the single, an extra large and strong link, or a shackle, is used to connect the block to the holdfast.

The rule for calculating the safe working load of chains is given at page 405.

Every precaution should be taken to ensure the utmost stability in the holdfasts; it is always far better to work with a good margin of safety than to incur the risk of letting the spars down, when, even should there be no accident to life or limb, much injury to valuable stores must almost of necessity ensue.

MOVING SHEER SPARS.

Sheer spars may be moved in the direction of their length on rollers, with a steadying handspike secured by square lashing to the spar, or laterally by parbuckling, but these methods are only applicable to short distances; when they have to be taken far they may be slung under the axletree bed of a siege limber by running it over the spar, up-ending the shafts, slinging the spar from the pintail close in rear of the centre of gravity, bearing down the shafts, and lashing the front part of the spar to the near shaft.

Light sheer spars may be suspended under a trench cart by running the cart over the spar, up-ending the shafts, slinging the spar close in rear of the centre of gravity by a rope secured to the shafts, and hitched round their butts, the shafts are then borne down, and the forward portion of the spar is lashed up to the shafts at their junction with the body of the cart.

Very heavy spars should be slung under a sling wagon.

Cases sometimes arise where none of the methods before described can be employed, as, for instance, when a heavy spar has been floated up to a rocky shore, and it becomes necessary to carry it, at any rate for some distance; this is best effected as follows: Lash levers or handspikes across the spar at short intervals throughout its length, man them, lift and carry the spar to the required spot.

It is dangerous to attempt to shoulder heavy spars, and apt to strain the men.

Sheers and Derricks.

STORES REQUIRED.

In the following details of the stores required for rigging, raising, and working light, medium, and heavy sheers, no provision has been made for holdfasts, because, in the first instance, the nature of the holdfasts must be entirely dependent on local circumstances, and secondly, the fullest possible information regarding every description of holdfast has already been given at page 408, and following. The details given are only approximate, and may require modification.

LIGHT SHEERS FOR WEIGHTS FROM 3 TO 5 TONS.

The stores, exclusive of holdfasts, required for rigging, raising, and working light sheers will, to a certain extent, depend on whether the head is to be lashed or connected with a head bolt.

WITH HEAD LASHING.

The following will be the stores required, and will suffice for raising the spars by either a derrick or lever:—

Axes, pick, helved	..	..	..	2	for preparing footings for shoes.
Blocks, wood	{ Snatch	..	{ 15-inch	..	2 for guys.
		..	{ 12-inch	..	2 for rigging derrick, &c.
	{ Bothway's	..	{ treble, 12-inch	..	2 for main tackle.
		..	{ double, 8-inch	..	2 for guy runners.
		..	{ single, 8-inch	..	2 " "
Cordage	{ Tarred	..	{ Hawser, 3-strand, 4½-inch, fathoms	..	113 in 2 half-coils for guys.
		..	{ Ditto, 2½-inch, fathoms	..	113 in 2 half-coils for guy runners.
		..	{ Ditto, fathoms	..	75 { in 3 lengths of 25 fathoms each, for side guys of derrick or lever.
	{ White	..	{ Yarn, spun, lbs.	..	2 for seizing, &c.
		..	{ Hawser, 3-strand, 4-inch, fathoms	..	113 for main tackle fall.
		..	{ Ditto, 3-inch, fathoms	..	25 for head lashing of sheers.
Crabs, capstan, complete	..	..	..	1	for main tackle.
Handspikes, common, 6-feet	..	..	..	8	for moving gun, &c.
Levers, wood, 14-feet	..	..	..	1	for raising sheers.
Mallets, wood	..	..	..	2	for tautening head lashing.
Mauls, wood, helved, iron-hooped	..	..	..	9	for driving pickets.

Sheers and Derricks.

Posts, picket, garrison, 5-feet *	
Ropes {	Drag, heavy 4 for steady ropes, &c.
	Gasket, white or tarred, $4\frac{1}{2}$ -inch 1 for stoppering fall.
	$1\frac{1}{2}$ -inch " fathoms 48 for anti-twisters, in 4 lengths of 12 fathoms.
	Lashings { $2\frac{1}{2}$ -inch, white or tarred, 5 fms. each } * for rigging derrick, &c., &c.
	$1\frac{1}{2}$ -inch, white or tarred, 3 fms. each } 6 for rigging head of lever, &c.
	Parbuckle, $4\frac{1}{2}$ -inch, white or tarred, 18 fathoms .. } 1 for back guy of derrick
Scotches, of sorts	12 for scotching spars and gun.
Selvagees	6 for general purposes.
Shovels, universal, helved	4 for preparing footings for shoes.
Skids, wood {	Fir, $4' \times 12'' \times 12''$.. 4 for skidding spars.
	Oak, $3' \times 9'' \times 6''$.. 6 for skidding gun, &c.
	" $3' \times 4'' \times 4''$.. 4 for " "
Slings, white rope, 6-inch, 12 feet ..	5 for guys, main tackle, and securing crab, and slinging weight.
Steps or shoes, wood {	for foot of sheers 2
	for foot of derrick 1
Tackles, luff, complete	3 for foot tackles of sheers and connecting feet of ditto.
Timber, spars {	40-feet, mean diameter } 2 for sheer legs.
	13 inches .. }
	25-feet, mean diameter } 1 for derrick.
	7 inches .. }
Thimbles, round, to take hook of 15-inch blocks.	3 for guy and main tackle straps.

In this list provision is only made for one back guy.

WITH HEAD BOLT.

When light sheers are rigged with head bolt and wire guys, the stores required, exclusive of those for holdfasts, will be as follows, and will suffice for raising them, either by derrick or lever:—

Axes, pick, helved	2 for preparing footings for shoes.
Blocks, wood {	Snatch, 12-inch .. 3 for running ends of guys and main tackle.
	Bothway, treble, 12-inch 4 (2 for guy tackle, 2 for main tackle).
	Do. double, 12-inch 2 for guy tackles.

* As required for holdfasts, lashing leading block of main tackle, &c., &c.

Sheers and Derricks.

Cordage	{ Tarred	Hawser, 3-strand	113 in two half coils for
		4-inch, fathoms	guy tackle falls.
		Yarn, spun, lbs...	2 for seizing, &c., &c.
	{ White,	hawser, 3-strand	113 for main tackle fall.
		4-inch, fathoms ..	
Crabs, capstan, complete	..	..	3* for main & guy tackle
Handspikes, common, 6-foot	..	..	8 for moving gun, &c.
Hammers, claw ..	..	..	1 for unkeying shackle bolts, &c.
Levers, wood, 14-foot	..	..	1 for raising sheers.
Mauls, wood, helved, iron hooped	..	..	9 for driving pickets.
Posts, picket, garrison, 5-feet	..	..	†
Ropes	{ Drag, heavy	..	4 for steadying ropes, &c.
		Gasket, white or tarred	
		4½-inch	3 for stoppering falls.
		Hawser, 3-strand, 1½-inch, fathoms	40 for anti-twisters.
		Lashings { Tarred, 2½-inch, 5 fathoms each	†
		Or white, 1½-inch, 3 fathoms each	6 for rigging head of lever, &c.
		Parbuckle, 4½-inch, 18 fathoms	1 for back guy of derrick.
		Iron wire, 3½-inch, in 22-feet lengths, with thimbles and shackles	6 ‡ for guys.
		Scotches, of sorts	12 for scotching spars, gun, &c.
		Selvagee	6 for general purposes.
Shovels, universal, helved	..	..	4 for preparing footings for shoes.
Skids, wood	{ Fir, 4' × 12" × 12"	..	4 for skidding spars.
		Oak, 3' × 9" × 6"	6 for skidding gun, &c.
		„ 3' × 4" × 4"	4 „ „
Slings, white rope, 6-inch, 12-feet	..	..	3 for securing capstans
Steps or shoes, } for feet of sheers	..	..	2
wood .. } for derrick	..	..	1
Tackle, luff, complete	..	..	3 for foot tackles of sheers and connecting feet of ditto.
Timber, spars	{ 40-feet, mean diameter	13 inches, with head bolt, &c., complete	2 for sheer legs.
		25-feet, mean diameter	
		7 inches	1 for derrick.

* The guy tackle may be worked by either capstan or by hand, according to the number of men available.

† As required for holdfasts.

‡ Or 2½-inch if of steel wire rope.

Sheers and Derricks.

RIGGING LIGHT SHEERS (WITH HEAD LASHING).

The position of the feet and holdfasts for guys having been marked out in the manner previously indicated, the sections bring up the stores required for the various duties they have to perform:—

No. 1 section, head lashing, mallets, slings or straps for main tackle and guys, skidding and scotches for head.

No. 2 section, shoes for the feet, picket posts, foot tackles, and selvagees; picks and shovels if required.

No. 3 section, fore guy and runner tackle, complete with anti-twisters, selvagees, and pickets.

No. 4 section, same as No. 3, and in addition, the stores required for raising the sheers when raised by back guy.

No. 5 section, main tackle, leading block and lashing, sling and steadying ropes.

No. 6 section, crab capstan complete, with sling and skid for securing it, gasket and pickets.

All sections using pickets provide lashings and mauls; all require spun yarn for mousing, &c. The spars are placed in position as near as possible to where they are to be lashed. The various methods of moving them will be found described at page 645.

No. 1 SECTION. RIGGING THE HEAD.

The head is rigged by No. 1 section as follows:—The lashing is made fast to the lower spar above where they cross with a timber hitch, as many turns are taken round both spars towards the feet as may be necessary to cover the cross, the end then led round this lashing and both spars where they cross, and four or five frapping turns taken so as to bring them together, and the end made fast round the upper spar above the cross.

There are two ways of putting on the straps for the main tackle and guys, which are applicable according as they are used on the single or the double.

The former is the most simple and affords ample strength if 6-inch straps fitted with thimbles are used.

The strap for the main tackle is first put on by raising the butt and slipping it up one of the spars, and over the centre of the head lashing; its bight, which is fitted with a thimble, should hang low enough to enable the upper block of the main tackle to swing clear between the spars in heeling.

Should it be required to shorten it, one or more turns are taken with the strap round the head of one of the spars.

The guy straps, which are secured to the spar furthest from the guy, are put on as follows. The bight of the strap opposite to the thimble is applied to the spar at *a*, Fig. 3, and the returns passed round both spars as shown in the diagram.

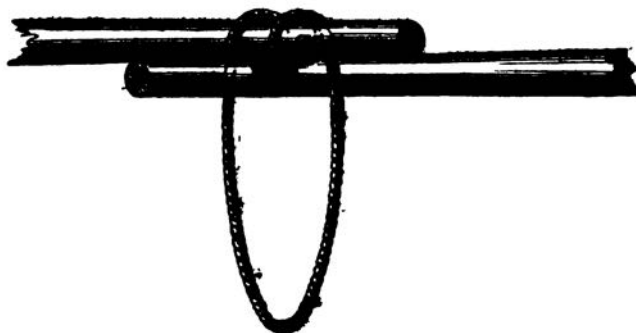
(A. M.)

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 Sheers and Derricks.

Fig. 3.

(Guy strap on the single.)



The other guy strap being put on in the same way, the strain of either guy tends to bind the spars together:

The blocks when hooked in are moused.

When the straps are used on the double they are put on in a very similar manner: viz.,

A guy strap having the splice in the centre, so that it cannot come into either bight, is laid between the spars and equally divided, each end led round the spar farthest away from the guy for which it is intended, and the ends brought back round both spars ready for the guy block to be hooked and moused. The other guy strap is put on in the same manner, the strain of either guy thus tends to bind the spars together. The main tackle sling is then put on over the crutch from front to rear, passing over the whole of the straps, except the bights for the head blocks.

The upper block of the main tackle is then hooked to both bights of the main sling and the hook moused.

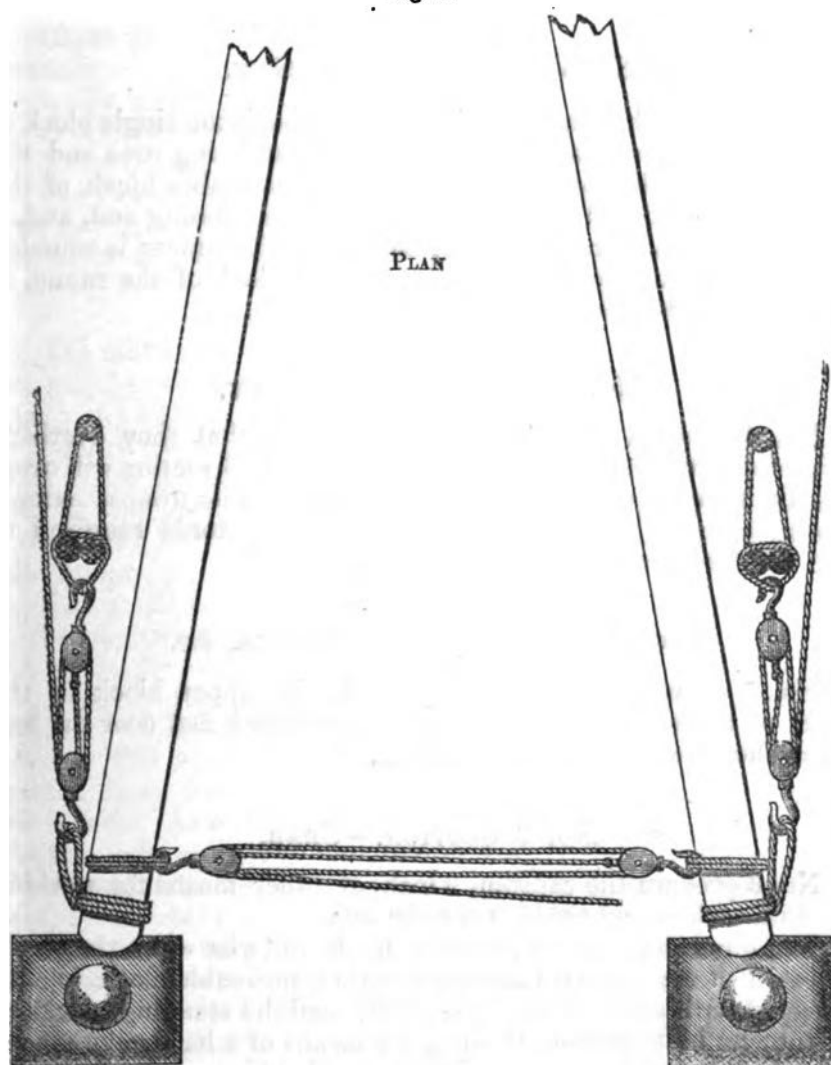
NO. 2 SECTION.—THE FEET.

No. 2 sink or lash the shoes for the feet. They must be on the same level, and in bad ground, prevented from sinking or slipping by placing planks, brushwood, or old timber underneath.

Fig. 4. shows the arrangement of the foot tackles, the holdfasts for which should be established so that the tackles may lie on the outside of the spars, but as near to them as convenient.

 Sheers and Derricks.

Fig. 4.



The straps connecting the moveable blocks to the butts of the spars should be of such a length that the blocks may be clear of the spars when the latter are on the ground; they should be made fast as close to the end of each spar as possible, and should come off in the centre underneath. The butts of the spars are maintained at the proper interval apart by means of a tackle or lashing between them, Fig. 4.

The following instructions for Nos. 3 and 4 sections as to guys are intended for light sheers rigged with guys giving a power of 2 to 1, and fitted with luff tackle runners, the holdfasts for the fore and back guys being assumed to be twice the length of the spars from the feet. Under these circumstances it will be found that three times the length of the spars is the most convenient

(A. M.)

2 T 2

Sheers and Derricks.

length for the guy falls, measured from the holdfast to the point of attachment of the guy runner.

No. 3 SECTION.—FORE GUY.

No. 3 prepare holdfasts for the fore guy, hook the single block of guy to the strap at head of sheers. The guy being rove and the standing end made fast at the holdfast, the moveable block of the guy runner is secured by a hawser bend to its running end, and, if the sheers are to be raised by the back guy, the runner is rounded in to the necessary extent. The standing block of the runner is secured at the holdfast by a strap or otherwise.

No. 4 SECTION.—BACK GUY.

No. 4 proceed in the same way, except that they overhaul their runner tackle. If raised by the fore, No. 3 section will overhaul their tackle and No. 4 round in theirs to its utmost extent, before making it fast. They also prepare the stores required to raise the sheers, as hereafter described.

No. 5 SECTION.—MAIN TACKLE, &c.

No. 5 reeve the main tackle, hook the upper block to the bights of the slings, and make the lower block fast near the feet of the sheers with temporary lashing.

No. 6 SECTION.—CRAB.

No. 6 prepare the capstan, winch, or other means for working the main tackle, and holdfast for the same.

The guys and runners are very liable to twist when the strain comes on them; to guard against this their moveable blocks should be rigged with anti-twisters (page 399), and the standing blocks of the runners be kept from twisting by means of a handspike placed through the returns of the fall at the holdfasts. Leading the running end of the runner somewhat off to a flank further aids in preventing twist.

When the sheers are rigged ready for raising, the butts of the spars should rest on the shoes a little in front of the hollow intended for their reception.

The slack of the tackle connecting the butts of the spars and of the foot tackles is hauled in, and the former are made fast; should the straps connecting the foot tackles with the butts of the spars not be made fast very low down on the latter, the foot tackles will require to be eased up a little from time to time as the spars rise; should this be neglected they will probably carry away. They should, under any circumstances, be narrowly watched during the operation of raising the spars.

Sheers and Derricks.

RAISING THE SHEERS.

Light sheers may be raised by any one of the following methods:—

1. By lever.
2. By the cheeks of a gyn.
3. By derrick.

The two first methods are applicable when the sheers are rigged with guys giving a power of two to one; the derrick can be employed in any case, no matter how the guys are rigged.

BY LEVER.

The foot tackles having had their slack taken in, the slack of the guy by which it is intended to raise the sheers is taken in by hand; a 14-foot lever or some similar spar is then placed parallel to the guy with its small end close to the single guy block at the head of the sheers, and its point or butt either placed in a shallow hole in the ground, made for the purpose, or butted up against a skid held by pickets, or secured by foot ropes, as may be most convenient.

The small end of the lever is made fast to the running end of the guy (which should have had about 3 feet paid back through the block) by means of light lashing, and is fitted with side guys, one passing over the standing end of the sheer guy, secured to holdfasts in line with its butt, to ensure its rising in a vertical plane. The running end of the guy runner is now manned and walked away with, when the lever will rise and lift the head of the sheers. As soon as the lever ceases to act in raising the head of the sheers its side guys must be cast off from the holdfasts. The sheers will now be high enough to be under the control of the guy, by means of which the operation of raising is completed.

The lever may now be removed, but before doing this it is advisable to mark the point of attachment to the guy with a piece of spun yarn, if it is intended to make use of the lever for striking the spars; or it may be marked before the spars are raised.

When the spars are at about 45° , by giving a little slack on the foot tackles the butts of the spars will slide into the shoes.

In striking the spars, the lever being secured to the guy as before, long foot ropes are made fast to the point or butt, by means of which it is guided into the same position it occupied in raising the sheers. The spars must be heeled over to enable the lever to be attached.

BY CHEEKS OF A GYN.

Using the cheeks of a gyn as a crutch.

The prypole and windlass having been removed from an 18-foot light gyn, the cheeks bolted together, are placed upright between the sheer spars as near the head as possible, with a fore and back guy to raise and keep them in position; the standing end of the guy by which the sheers are to be raised is allowed to

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rest on the head bolt of the gyn. The running end of the guy runner is then manned and walked away with, and the sheers will rise. When the raising is completed, the gyn cheeks may be struck and removed.

The spars may be struck in a similar manner.

BY DERRICK.

The operation of raising by derrick will be found fully described at page 78.

The head of the sheers should be skidded at a sufficient height to allow the running end of the main tackle fall as it passes from the snatch block at the foot of the derrick to the crab to pass clear of the sheer spar, underneath, the snatch block being lashed as low down on the derrick as possible.

LIGHT SHEERS WITH HEAD BOLT.

In rigging sheers with head bolt, the following points should be attended to.

The holes bored in the head of the sheer spars for the reception of the iron bolt, form an angle with the spars such as would result from a line drawn at right angles to the medial line, passing through points midway between the butts and the heads of the spars when splayed to one-third their length. Such being the case, it is obvious that unless the spars be placed in a suitable position, it will be impossible to insert the bolt. The mode of procedure should therefore be as follows:—

The spars are placed with their heads skidded up, approximately in the desired position, and the head bolt is inserted in one spar up to the shoulder, and the spar rolled until the bolt lies exactly horizontal; the butts of the spars are then arranged at an interval apart from centre to centre, about 18 inches more than the regulated splay (one-third the length of the spars).

A steadying handspike being now secured with square lashing to the spar which has to be drawn on to the head bolt to keep the hole in the head horizontal, the spar is drawn in on to the bolt, both head and butt being moved simultaneously.

Careful observation will show whether the hole in the head of the spar is in prolongation of the bolt, if not the position of the spar must be corrected.

The employment of undue force is to be avoided for fear of straining the bolt.

When the bolt is home on both spars, the washers are put on on the outsides and keyed up.

In some light sheers rigged with a head bolt provision is made for their being rigged with either one back guy for moderate angle of heel, or with two back guys for extreme angles of heel (say over 20°).

The head bolt is fitted to carry three shackles, one for the upper block of the main tackle, and two for the wire guys (when

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rigged with *one* fore and *one* back guy); when rigged with two back guys the points of attachment are strong links or shackles at the head of each spar, into which the upper lengths of the wire guys are shackled, the fore guy being secured to the centre of the head bolt as before.

The methods of raising either by lever or by derrick will be found described at page 78.

MEDIUM SHEERS WITH HEAD LASHING.

Medium sheers for raising weights of from 5 to 12 tons require much the same stores as already detailed for light sheers, with the following exceptions:—

The spars would be probably from 40 to 50 feet in length, with a mean diameter from 13 to 16 inches, according to the weight to be raised.

The derrick to be used for raising would be a spar from 26 to 30 feet in length, with a mean diameter of from 8 to 9 inches.

The guys of 6-inch rope may be rigged so as to give a power of 3 to 1.

To effect this the standing end of the guy is made fast to the head of the spar furthest from it, then led through an 18-inch single block at the holdfast, and thence through an 18-inch single block hooked into the guy strap at the head of the sheers.

The guy straps of 7-inch or 9-inch rope, fitted with thimbles, are used on the single.

The guy runners for weights not exceeding 7 tons at moderate angles of heel, may be the same as for light sheers; for 12-ton guns it would be advisable to employ runners consisting of one double and one single 10-inch Bothway blocks rove with a coil of 3½-inch rope, the running end being led away through a 10-inch snatch block at the holdfast to the crab capstan or winch by which the guy is to be worked.

The main tackle would consist (according to the weight) either of two treble 12-inch Bothway blocks rove with a coil of 4-inch rope, or of two treble 18-inch Bothway blocks rove with a coil of 6-inch rope, with leading blocks to match.

The strap for the main tackle 7-inch or 9-inch rope sling fitted with thimble.

For raising 7 and 12-ton guns it would be advisable to make use of a crab winch for the main tackle, and in the latter case to aid the work by employing a "messenger," for which purpose either a second winch or a crab capstan may be made use of, *vide* page 497.

Head lashing 30 fathoms of 3-inch white rope.

Light gyn tackles may be used for the feet, the straps used to secure them being of proportionate strength.

For extreme angles of heel the sheers should be rigged with two back guys.

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The holdfasts must be of ample strength for the strains likely to be thrown upon them.

RAISING THE SHEERS.

Medium sheers are raised by means of a single derrick, its butt being placed in a shoe midway between the sheer spars at about two-thirds of their length from their butts, between which its head is skidded up, 4 or 5 feet from the ground. It may be observed that the higher the heads of the sheers and derrick are skidded, the easier will it be to raise the latter. The method of raising is the same as described at page 78.

The foot of the derrick should be lashed in a direction opposite to that of the crab taking in the main tackle fall, to prevent its moving towards the crab in raising.

HEAVY SHEERS.

A list of the stores required for heavy sheers for 25-ton guns is given at page 657.

As a rule the sheers would be fitted with head bolt, and furnished with wire guys, and with short chains for suspending the upper blocks of the main tackles.

When not so fitted, the head lashing should consist of about 35 fathoms of 4-inch white rope, the guy straps of 9-inch white rope fitted with thimbles.

The guys each of a coil of 6-inch rope rove through one single and one double 18-inch Bothway block, the double block being moveable, and therefore giving a power of 4 to 1.

The running end of each guy fall would lead straight away from the double or moveable block to the barrel of the 5-ton crab, by which the guy should be worked.

A guy so rigged with a new fall would be capable of exerting a strain at the head of the sheers of nearly 15 tons (and about 13 tons if rove with worn rope), without exceeding the safe working strain of the rope.

One such guy would therefore be sufficient for moderate angles of heel when raising 25-ton guns, and two would afford sufficient strength for any angle of heel required.

More powerful combinations of tackle (such as double and treble blocks), necessitate two coils of rope being spliced together for the fall, and are unwieldy and slow in working.

RIGGING.

The methods of connecting the spars, whether by head-bolt or lashing, attaching guys, guy straps and foot tackles, are the same as described for light sheers at page 649.

RAISING AND STRIKING.

The operations of raising and striking the sheers are identical with those described for heavy sheers for 38-ton guns at page 659.

Sheers and Derricks.

STORES REQUIRED.

Name of Store.	For raising Guns of		Remarks.
	35 and 38 tons.	18 to 25 tons.	
Axes, pick, helved	4	4	
Blocks ..	21-inch	*4 ..	For altering lead of main tackle and guy runner, falls.
	Snatch .. 18 "	2 4	For derrick and main tackle at foot of sheers, &c.
	15 "	.. 1	Back guy of derrick.
	Bothway's treble 21 "	*8 ..	4 for main tackles, 4 for guys
	Do. do. 18 "	.. 4	For main tackles.
	Do. double 18 "	.. 2	} For guys.
Chains, iron, short link, 12 fathoms	Do. single 18 "	.. 2	
	With shackle and bolt and special thimble for the bight, large enough to take the hook of a 21-inch block	1½-in. *2 ..	For holdfasts for standing blocks of guys.
	1 "	2 ..	For leading blocks at holdfasts.
	With shackle and bolt	1 " ..	2 For holdfasts.
	With 5-inch rings at ends	1½ " ..	*2 Ditto.
	" " ¾ "	4 ..	For holdfasts, as required.
Cordage	" " hawser, 3-strand, 2½-in. fathoms	.. 60	12 lashings of 5 fathoms each.
	Tarred yarn spun lbs.	6 5	{ 2 coils for main tackles. 2 coils for guys.*
	7-inch	452 ..	
	6 "	.. 452	Ditto ditto.
	6 "	113 ..	Ditto ditto.
	4½ "	.. 56	Back guy of derrick.
	4 "	.. †85	Head lashing.
	4 "	113 113	2 half-coils for side guys of derrick.
	White hawser-laid, fathoms	3 " ..	24 2 lashings for snatch blocks at foot of sheers.
	3 "	.. 6	Lashing leading blocks to foot of derrick.
	2½ "	.. 9	Head lashing of derrick.
	2½ "	.. 8	2 pieces of 4 fathoms each, for lashing blocks of tackles to derricks.

* If rigged with two back guys provision must be made accordingly.

† Not required for sheers which have the head fitted with iron bolt, wire guys, and hooks and chain, for attaching main tackles.

Sheers and Derricks.

STORES REQUIRED—*continued.*

Name of Store.	For raising Guns of		Remarks.
	35 and 38 tons.	18 to 25 tons.	
†Crabs, iron, double purchase 5-tons	4	4	2 for main tackle, 2 for guys.*
Crab, capstan	2	..	For hauling forward feet of sheers, when raised.
Grease, mineral lbs.	6	6	
Mauls, wood, helved { common ..	6	6	} For driving pickets.
{ iron hoop ..	6	6	
Pile drivers, Swiss, complete ..	3	3	
Planks, wood, moving guns, { Fir ..	20	8	For placing under coils of rope and for holdfasts.
{ Oak ..	12	6	For placing under shoes or feet of sheers.
Posts, picket, garrison { 8-feet ..	32	12	} For holdfasts.
	5 " }	20	
	..	12	Holdfasts for foot tackles of derrick.
Ropes { Gasket, white { 7-inch ..	..	*4	} For crabs.
	6 " ..	..
	1½-inch, tarred or white fms.	80	For anti-twisters.
	2½-inch, tarred fms. 5	30	Lashing pickets, &c.
	Lashings { 3 " white " 10	6	Lashing blocks on derrick.
	4½ " " " 12	2	For lashing lower blocks of main tackles to spars.
	Drag, heavy	6	General purposes.
	§Wire guy, 7-inch (in 30-foot lengths)	*8	} For guys.
§Wire guy, 5½-inch fitted with shackles, in 30-foot lengths	..	*6	
Rollers, elm 6' x 10'	8	..	For moving spars and crab winches
Selvagees	12	12	General purposes.
Shovels, universal, helved ..	6	6	
||Skids, wood { fir, 12 in. square by 6 feet long	20	12	Skidding spars, &c.
	oak, 12 in. square by 14 feet long	2	For heavy holdfasts.
Slings, white rope { 9-inch, 16 feet, with thimbles	..	†4	Two for guy straps, two for main tackles.
	8-inch, 9 feet ..	1	For head of derrick.
	6-inch, 12½ feet {	2	For securing capstans.
	6-inch, 12½ feet.	..	For foot tackles.
	..	1	One for head of derrick.

* If rigged with two back guys provision must be made accordingly.

† Not required for sheers which have the head fitted with iron bolt wire guys, and hooks and chains, for attaching main tackles.

‡ If only 2-ton crabs are available, the extra power required must be got by "messenger," for extra winches.

§ If steel wire guys are supplied, the size will be less.

|| Short (Service) oak skidding, such as 6' x 9' x 3', &c., &c., as required.

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STORES REQUIRED—*continued.*

Name of Store.	For raising Guns of		Remarks.
	35 and 38 tons.	18 to 25 tons.	
Steps or shoes, wood, for feet of sheers	8	3	Two for sheers, one for derrick.
Tackles	Gun, white 3-inch rope, 16 fathoms, 1 double and 1 treble 9-inch Admiralty blocks	1	3 { For foot tackles of derrick. Runner for back guy of derrick.
	5-inch rope, 18 fms.	4	.. For foot tackles and moving feet of sheers
	4 " " 18 "	..	2 For foot tackles of sheers.
	3½ " " 16 "	2	.. For foot tackles of derrick.
	Luff, tarred, 2½-in. rope, 10 fathoms, with 1 double and 1 single 8-inch Admiralty blocks	4	4 For derrick, side guys, &c.
Timber, spars for sheers and derricks	70-feet, mean diameter about 24 inches	2	.. Sheer legs fitted with head bolt and chains for main tackles.
	60-feet, mean diameter 20 inches	..	2 Sheer legs.
	50-feet, about 15 inches	1	.. { For derricks.
	40-feet, 12 inches	..	1
	30-feet, 10 inches	1	.. For securing across feet of sheers when moving them to the front.
Thimbles, round, to take hook of 18-inch blocks	..	4	For use with straps (9-in.) for guys and main tackles
Shackles, heavy* .. .. .	..	4	Capable of taking 18-inch blocks at holdfasts.

N.B.—The stores required for the holdfasts must in a great measure depend on local circumstances, those given above are for ground capable of being excavated.

Should it be required to heel sheers, when raising 18 to 38-ton guns, at an angle greater than 15° from the perpendicular, they should be rigged with two guys on the side which has to take the weight at extreme heel.

This detail only makes provision for one back and one fore guy, and if more are required demands should be framed accordingly.

HEAVY SHEERS FOR 35 AND 38-TON GUNS.

The strength and stability of the pier or wharf on which the feet of the sheers are to rest, must determine how near the edge of the masonry the shoes for the feet can be placed without endangering the structure, and it is most essential that reliable information on this point should be obtained, and the shoes placed as near the edge as they can be with safety, for it must be borne

* If rigged with two back guys provision must be made accordingly.

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in mind that even with 70-foot spars at 20 degrees of heel, it is only possible to pick up a weight at a distance, measured horizontally, of about 23 feet from where the feet of the sheers rest.

The vessel from which the guns have to be disembarked will probably have considerable beam, and unless the head of the sheers can be brought nearly over the main hatchway, much trouble and inconvenience will probably result in lifting the guns. Tackles exerting an outward strain, may be employed to bring the suspended weight fairly over the centre of the hatchway.

Excessive heel is, if possible, to be avoided, from the great strain it throws on the back guys and their holdfasts, and the consequent increase of thrust on the spars.

The utmost attention should be given to the emplacement for the shoes which are to carry the feet of the sheer spars, so as to secure a thoroughly solid and stable foundation, and also to the whole of the holdfasts. Every precaution should be taken to guard against "twist" in any of the tackle about to be employed in raising and working the sheers.

All the gear should be most carefully overhauled with a view to discover defects.

Cordage should be kept as far as possible free from wet (especially from salt water) and dirt.

All blocks should be carefully examined, cleaned, and thoroughly well lubricated before use, as well as the winches, whose bearings should be oiled, and the bearing surfaces of the cogs cleaned and greased.

In the case of placing such sheers about 15 feet inboard from the edge of a dock or pier, the following method of raising will probably have to be resorted to.

The spars having been got into the required position for rigging, are put together, the guys secured and the main tackles hooked on, their lower blocks being near the foot of the spars, to which they should be securely lashed (each with a lashing of 3-inch white rope about 18 fathoms long); the foot tackles may consist of 18-foot heavy gyn tackles attached to the feet of the spars by 6-inch slings of sufficient length for the tackle to lie clear of and outside the spars when on the ground.

Care must be taken that the shells of the upper blocks of the main tackles lie flat to the spars, so that, when raising with the derrick by means of the two running ends of the main tackles, the shells of the upper blocks will not be strained or broken from the fall bearing against them.

A stout spar about 30 feet in length and 1 foot in mean diameter, should be lashed across the feet of the sheer spars as near the butts as possible with square lashing of 3-inch rope.

The object of this spar being to keep the feet of the sheers at the proper interval in raising, and also to enable the sheers, when raised, to be moved into the required position near the edge of the pier in the manner described farther on.

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DERRICK.

The derrick to be employed for raising the sheers should be placed with its butt midway between the spars and about 50 feet from the butts of the sheer spars, its head being away from the head of the sheers and skidded at a convenient height for rigging.

The head of the derrick is rigged as follows:—

A V-shaped slot should be cut with a saw in the head of the derrick, athwart the plane in which it will rise; a short 7-inch or 8-inch sling or strap should be placed with its centre in the centre of the slot, the two ends (fitted with thimbles) laid along the spar and temporarily secured with a piece of light lashing; the sling should then be lashed to the spar with about 10 fathoms of 3-inch white rope.

The back guy of the derrick should consist of two returns of 6-inch rope passed through an 18-inch single or snatch block lashed to the head over the lashing securing the sling before described, and the running end of the guy be fitted with a runner tackle of suitable strength, such as a light gyn tackle.

There should be three side guys, it being convenient to have two on that side of the derrick on which the back guy of the sheers will lie before raising, viz., one side guy lying over it and one under; their use is described further on under the head of *Raising the Sheers*. These guys may consist of 4-inch rope, and be secured to the top of the derrick by a clove hitch, and to the holdfasts by means of a heavy gun tackle, to enable them to be readily hove in or slacked off. The holdfasts for the derrick side guys should be exactly opposite to its butt.

Stout foot tackles are necessary for the foot of the derrick, two heavy gun tackles answer well for the purpose.

Before raising it, the head of the sheers should be skidded at such a height from the ground, that the running ends of the main tackle falls may pass clear underneath the sheer spars from the snatch blocks at the foot of the derrick to the winches. For the same reason these snatch blocks should be lashed as close to the butt of the derrick as possible.

By crossing the two running ends of the main tackle falls between the upper and lower snatch blocks of the derrick, the necessity for shifting the coils of rope from one winch to another, before working the sheers, will be avoided.

The derrick may be raised in the following manner:—

The two cheeks of an 18-foot light gyn are placed one on each side of the spar, their heads connected by the head bolt and their feet lashed close to the ground with a heavy drag rope, to prevent their slipping outwards beyond their usual splay.

The running ends of the two main tackle falls passing from the head of the sheers to the head of the derrick are laid over the

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head bolt of the gyn, which is then raised perpendicular and secured in that position by its temporary fore and back guys.

The slack of the foot tackles of the sheers and derrick is taken in, and the falls are made fast.

The winches may now be worked to take in the running ends of the two main tackle falls, and the derrick be thus raised, until it comes in contact with the head of the gyn, which is then struck and removed.

The winches are again worked, and the derrick raised until nearly perpendicular, when its back guy is made fast.

In raising the derrick its side guys must be attended to, to ensure its rising in a vertical plane.

Another method of raising the derrick is by means of a lever made fast to the running end of its back guy, see page 676.

In this case the head of the derrick before raising lies over the head of the sheers, and its butt towards their feet. When the derrick is vertical its foot may be hauled towards the head of the sheers until it falls into the shoe placed to receive it.

RAISING THE SHEERS.

On the winches continuing to work, the head of the sheers will commence to rise.

It is most necessary to narrowly watch the foot tackles as the sheers rise, and to cautiously ease them up a little from time to time whenever the strain on them is becoming excessive; in doing this a couple of round-turns should always be kept with the running end of the fall round the holdfast,* or the spars may by a sudden movement overpower the Nos. easing off and come down with a run.

The fore guy must be well overhauled so as not to check the spars rising; the back guy should not be tautened until the head of the sheers approach the head of the derrick, or an undue strain would be thrown on the foot tackles of the sheers.

The derrick will raise the spars in this manner until they form an angle of about 35° with the horizon, when the weight of the sheer spars may be taken by their own back guy, and the raising be thus completed.

By now "walking back" on the two main tackle winches, the derrick is gradually lowered to the ground, when it may be unrigged and removed.

As that side of the derrick on which the back guy of the sheers lies is rigged with two side guys (one lying over and one under the back guy of the sheers), it enables the lower side guy to be hauled taut and made fast, and the upper side guy to be cast loose, as soon as the back guy of the sheers comes, in the process of raising, in contact with the latter.

N.B.—In raising the sheers with the derrick, the head of the

* It is desirable to lead the running end of the foot tackles round a holdfast established well clear to either flank.

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latter must be kept in the same vertical plane with the head of the sheers, or one of the derrick side guys will be subjected to undue strain.

MOVING THE SHEERS TO THE FRONT WHEN UP.

If the spars were rigged, as would probably have to be the case, with their head lying just within the edge of the pier or dock, and it is required to get them into position with their feet only 15 feet inside the edge of the pier, it is evident that they will have to be moved about 55 feet to the front.

To do this, it will be necessary in the first instance to guard against the feet opening out beyond their proper interval, for should they do so, it would strain the headbolt. So, as an additional precaution, a light gyn tackle should be made fast between the feet of the spars, the slack hauled in, and the fall made fast: for when strain comes on the square lashings of the cross spar, the returns get stretched and slacken, and the feet, without the tackle just mentioned, might work outwards.

The next thing to be done will be to place broad oak planks under the feet of the spars, in line with the shoes where they are ultimately to rest. To effect this the guys, both fore and back, should be slacked two or three 14-foot levers applied as levers of the first order on each side of the foot to be raised and under the cross spar, the square lashings of which may be kept from slipping up the sheer spars either by cleats nailed on, or by a collar of lashing applied to the sheer spar just over the square lashing. The levers, which should be applied as close to the foot to be raised as possible, are then borne down, and a long broad oak plank is launched under the foot, its upper surface having been previously greased or soaped.

The other foot of the sheers is then treated in the same way.

Heavy gyn tackles are now made fast, one to each foot, to move it in the required direction. The running ends of their falls may (should hands be short) be taken in by crab capstans.

Check tackles, to prevent the feet slipping more than would be safe, should be employed, and two long levers at an angle of 45° with the horizon be applied under the cross spar, and close to the sheer legs on each side, if necessary.

The fore guy should be taken in, and the back guy slacked off as required.

It greatly aids the operation to keep the head of the sheers *slightly* inclined away from the direction in which the feet are being moved, and if the check tackles on the feet are properly kept in hand there is no risk in so doing.

The feet of the spars are in this way brought up to and lowered into their shoes.

SLINGING THE GUN.

35 and 38-ton guns have very small buttons, and to enable them to be safely slung at the breech, an iron ring to fit the

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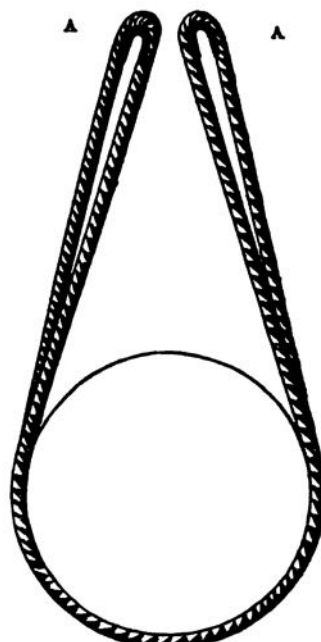
neck of the cascable, and carrying a shackle, has been issued, and affords the safest and best means of attaching the breech main tackle to the gun.

The sling for the muzzle main tackle should be placed at the halfweight mark.

A short 12-inch white rope sling with thimble is well fitted for the purpose.

Should the gun to be raised be so skidded as to interfere with the short 12-inch sling being slipped over the muzzle and back to the halfweight mark, it will be found convenient to use a 16-foot 9-inch white rope sling for the muzzle tackle.

Fig. 5.



9-inch white rope sling (fitted with circular thimbles A.)

This can be slipped under the gun in rear of the muzzle skid, and the two ends brought up and hooked on to the block of the muzzle main tackle.

Slings used to raise heavy weights should always be fitted with thimbles, otherwise their strength is greatly diminished, and, from the strands being cut into and partially destroyed by the hook of the block, the sling is very likely to part, and cause an accident.

It may be as well, as an extra precaution, to so lash the muzzle sling that it cannot slip towards the muzzle.

Throughout the operation, the axis of the gun should be kept horizontal, and lowering should be effected by walking back on the winches, and not by use of the brake.

Breech and muzzle-steadying tackles must be carefully attended to, and all usual precautions taken.

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STRIKING SHEERS.

For striking the sheers, the derrick being rigged as before, is raised by means of the main tackle winches, until the spar is at an angle of about 45 degrees. The sheer spars are then heeled over to the front by walking back on their back guy winches until the weight of the head can be taken by the derrick, after which, and until the spars are down, the sheer back guy tackle should be allowed to overhaul freely.

As soon as the sheers are down, the derrick may be struck by walking back on the main tackle winches.

NOTES ON THE GEAR REFERRED TO IN THE FOREGOING PAGES.

The weight of each sheer spar with its cast-iron cap is $6\frac{1}{2}$ tons.*

The estimated weight of the head of the sheers when rigged and ready for raising is about 8 tons.*

The weight of the crab winches when on their frames is about 3 tons each; they are fitted with double and treble purchase.

The power they are capable of being worked up to is 5 tons, direct from the barrel, on the slow speed. This is allowing eight men to a crab winch, and, presuming they each exert a force of 15 lbs. (or a total of 120 lbs. on the two handles), this amount of work could be exerted continuously without distressing the men. In placing crab winches the barrel must be at right angles to the rope it is required to take in, therefore, when the derrick is raised the winches are turned towards its butt, and when the sheers are being worked, towards their feet.

To alter the position of the winches it will generally be only necessary to cast off the lashing of one side or bracket, slew the winch through the required angle and secure it again. It saves trouble to substitute a tackle for the lashing on the side that has to be shifted.

PLACING SHEERS ON TOWERS, &c.

Sheers are sometimes required on works where there is not sufficient room to prepare them, as, for instance, on the top of parapets, forts, &c.

When this is the case they must be prepared below with their feet towards the slope or scarp.

It is difficult to lay down precise rules for placing them in such positions, but the following are the simplest means, and will serve as a guide:—

1. By taking them up an inclined plane formed of spars.
2. By means of a single derrick.
3. By means of a double-derrick.

* This has reference to a pair of very heavy sheer spars for raising 38-ton guns, prepared in the Royal Arsenal, 1876; such heavy spars would, however, seldom be met with.

Sheers and Derricks.

1. BY MEANS OF AN INCLINED PLANE.

This method is only applicable to light sheers, and in cases where the height to which they have to be raised is inconsiderable, and even then, in the generality of cases, it will be found more convenient to lift them into position with a single derrick; if, however, it should be decided to adopt it the mode of proceeding will be as follows:—

A strong spar is lashed across near the feet of the spars of the sheers on the side further from the work.

Two long uphirs or skids are leant against the scarp at such a distance apart that they are inside and close to the legs of the sheers under the cross spar, their butt ends projecting beyond the top of the slope or scarp, so as to allow the feet to rise above it before their support ceases; their points should be butted firmly into the ground.

The moveable blocks of two tackles are then made fast to the feet of the sheers, the standing to the butt ends of the two supporting spars.

The sheers having been raised nearly vertical by one of the guys passed over the work, are hauled up the spars, care being taken that the cross spar is kept at right angles to the uphirs, and the sheers at right angles to the inclined plane.

2. BY MEANS OF A SINGLE DERRICK.

This will usually be the most convenient method to adopt, as it is more simple and requires less gear than a double derrick. The length and strength of the spar made use of for the derrick will depend on the height and weight of the sheers to be lifted.

A spar about 45 feet in length, and having a mean diameter of 13 inches, would be suitable for placing any but the heaviest nature of sheers in position.

The operation may be briefly described as follows:—

The cheeks of an 18-foot light gyn are first hauled up to the top of the work or tower, and connected at top by the head bolt and at the foot by the lower cross-bar; the windlass is not used and the upper cross-bar is secured out of the way. The gyn cheeks being raised are kept vertical by one fore and two back guys, the former being made fast to the head bolt, and the two latter to the upper part of the cheeks, which are kept from closing in together on the head bolt by the guys being led somewhat outwards.

The hoisting tackle may consist of one double and one single 10-inch Bothway block, rove with a half coil of $3\frac{1}{4}$ -inch rope; the double block being hooked to the head bolt of the gyn, the running end of the tackle is led through a leading block attached to the foot of one of the gyn cheeks, thence to the crab to be used for

Sheers and Derricks.

raising the spar. The cheeks of the gyn are secured to prevent their moving towards the crab when the weight is taken.

The derrick spar having been brought close to the foot of the tower, the hoisting tackle is overhauled until its lower block is close to the spar, to which it is attached at the centre of gravity by a stout strap or lashing. Steadying ropes are made fast to the ends of the spar, which is then hoisted and placed in a horizontal position between the edge of the work and the feet of the gyn cheeks. The spar is slewed a quarter circle on its centre, being kept in hand by steadying ropes, the foot of one of the gyn cheeks being raised to allow it to pass under, and is then ready for rigging.

RIGGING THE DERRICK.

The derrick is rigged with one fore, one back, and two or three side guys, either one or two main tackles, as may be deemed desirable, and two foot tackles.

The head is rigged in a similar manner to that described at page 79.

The fore and back guy may each consist of a coil of 4-inch tarred rope rove through a 12-inch single or snatch block at the head of the derrick, and are each furnished with a runner tackle, consisting of one double and one single 8-inch Bothway block, rove with a half coil of 2½-inch tarred rope.

Each side guy consists of 4-inch rope with a luff tackle at its lower extremity. Two luff tackles having their double blocks lashed close to the butt of the derrick answer well for foot tackles. The nature of the main tackles, and whether one or two are used, will depend on the weight of the spars to be lifted; one advantage of employing two is that it admits of more simple tackles, and hence the raising is more rapidly effected. Two main tackles, each consisting of one double and one single Bothway block, rove with a coil of 4-inch rope, would in most cases give ample power. In such a case the double blocks would be hooked into the bights of the strap at the head of the derrick, and moused, and the tackles overhauled until the single blocks were close to the butt of the spar, where they would be strongly lashed. The spar would have been previously launched inboard until its butt lay close inside the shoe placed to receive it.

The hoisting tackle by which the derrick was lifted to the top of the work having been sent down from the head of the gyn cheeks, is replaced by two 12-inch snatch blocks, through which the running ends of the derrick main tackles are rove, whence they are led through similar blocks secured, one to the foot of each gyn cheek, to the crabs used for taking the weight.

Before the derrick is raised it should be borne in mind that if the sheer spars are more lofty than the derrick, the latter should be rigged with two side guys on that side on which the back guy of the sheers will be. One of the double side guys will be over and

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Sheers and Derricks.

one under the back guy of the sheers, the latter being brought into use and the former cast off as soon as the back guy of the sheers comes in contact with it, in the operation of raising the sheers.

It is sometimes desirable to get as much lift as possible when raising the sheers, or their feet may not be above the top of the work when the hoisting tackles are chock-a-block. When such is the case, either a very short strap, say of 5-inch rope, should be made use of for the upper blocks of the main tackles at the head of the derrick, or the blocks be lashed close up to the head, and be prevented from slipping down the spar by a collar of rope below the lashing.

N.B.—If preferred, a light single derrick may first be rigged and raised on the summit of the work, and by its means the heavy derrick be raised from below in a vertical position (already rigged) and placed in its shoe.

RAISING THE DERRICK.

The main points to be attended to in raising the derrick are :—

1. To see that it rises in a vertical plane; this is effected by hauling in or easing off the side guy tackles as required.

Both side guy tackles will require slacking off as the spar rises.

2. The foot tackles to be narrowly watched and eased up as required.

When all is ready, the slack of the foot tackles and side guys is taken in, the crabs for the running ends of the main tackles heave round, and the head of the derrick rises. When it has risen to about the level of the head of the gyn, the spar will be high enough to be under the control of its own fore guy, by means of which the operation is completed.

The butt of the spar may be allowed to slide into its shoe when the angle of inclination is about 45° .

Care must be taken as the spar approaches the perpendicular to keep the back guy well in hand. The whole of the guys having been made fast, the head of the gyn may be lowered by walking back on the main tackle crabs; the lower cross-bar being unkeyed, the feet of the cheeks are allowed to come inboard until the head of the gyn is close to the foot of the derrick, when the cheeks are taken to pieces and removed.

PREPARING THE SHEERS FOR RAISING.

The sheers are rigged in the usual manner, with their butts towards, and close to, the foot of the work on which they are to be placed.

Should the work be surrounded by water, they will have to be

Sheers and Derricks.

prepared on a raft of casks, pontoons, or barges, and floated into the required position.

A spar is lashed across the sheers near their butts (Fig. 7) to keep them at the required distance apart during the operation of raising.

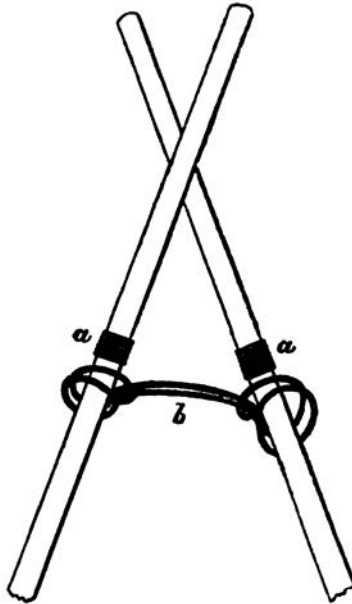
The derrick main tackles are securely lashed one to each sheer spar well above the centre of gravity, the lashings being prevented from slipping up the spars by collars of rope put on above them.

Foot ropes or tackles are employed to control the motion of the feet as the spars rise.

The running ends of the derrick main tackles being led through snatch blocks lashed to its foot, all is ready for raising.

When only one main tackle is employed for lifting the sheers, it may be secured to them by means of a 6-inch white rope gun sling, 12 feet long, applied in the following manner.

Fig. 6.



The sling being slipped over the spars before they are lashed, as shown in the diagram, is hauled taut till it grips. It is prevented from slipping up the spars by collars of lashing, *a a*.

The lower block of the derrick main tackle is hooked into the centre of the sling at *b*, and prevented from slipping to either flank by being cross-lashed with a bit of light lashing. The sling should be about two-thirds up the spars, measured from their butts.

As when sheer spars are thus suspended the sling has a tendency to bring the feet together, it is as well when lashing the spar across their butts to make a small allowance on this account of, say, about 6 inches.

Sheers and Derricks.

RAISING THE SHEERS.

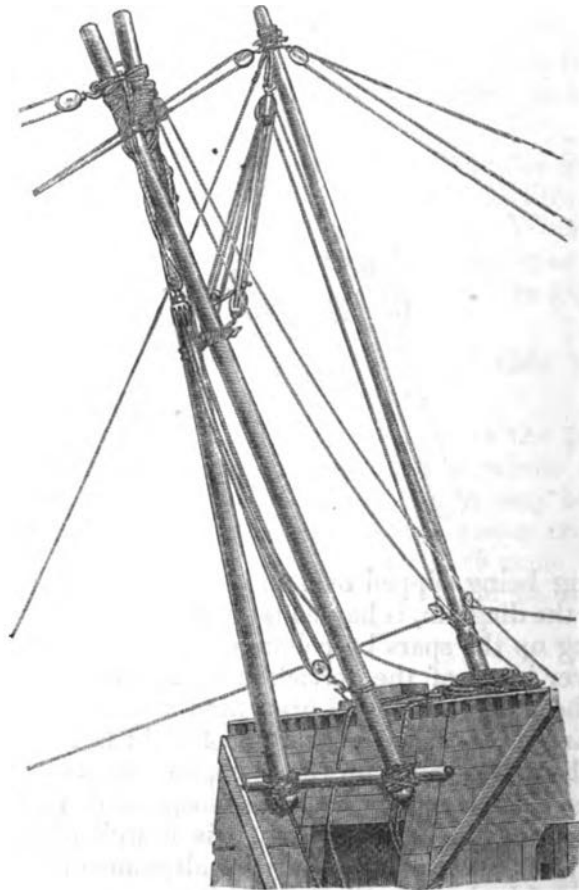
The head of the derrick having been slightly heeled outwards, the main tackle crabs heave round, and the sheers are raised, first into a vertical position, then bodily up until their feet are high enough to be brought over the shoes, into which they are lowered by walking back on the crabs. The fore and back guys of the sheers must be attended to as the spars rise, so as not to impede the lifting, or slew the head.

In subsequent operations with the sheers it is most likely that the derrick might be left standing without causing any inconvenience, its butt being cross-lifted to a flank out of the way, if necessary.

When raising sheers off a floating raft, the butts of the spars should be kept from sinking, as the sheers rise from the horizontal to the vertical, by suspending them with tackles from the top of the work.

Lowering the sheers and derrick is the exact converse of the foregoing.

Fig. 7.



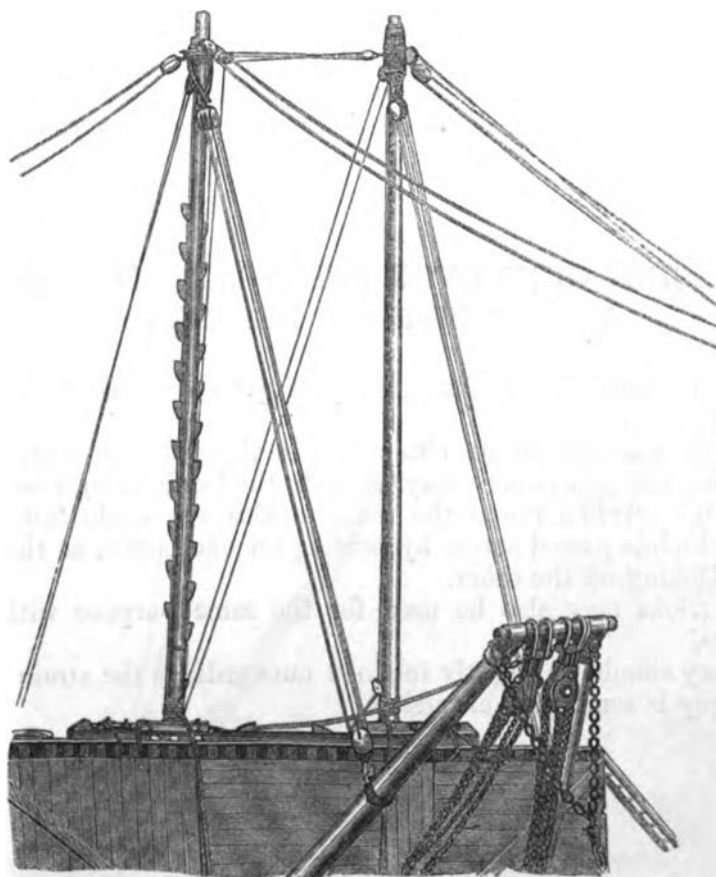
Sheers and Derricks.

Another method of erecting a single derrick on the summit of a work is to first erect a smaller derrick, such as a 25-foot spar, by means of a lever, which small derrick is made use of instead of the gyn cheeks, but in precisely the same manner as that already described.

TO PLACE SHEERS WITH A DOUBLE DERRICK.

When very heavy sheers have to be placed on the summit of a work, a double derrick may be employed. The derrick spars are prepared and erected in the manner already described, except that the heads may be connected (Fig. 8), thus rendering one side guy for each derrick sufficient, and each has but one main tackle. The tackle connecting the heads of the two derricks should be double, one lying over and one under the back guy of the sheers, for the same reason that it was necessary, as described at p. 667, to rig the single derrick with a double side guy on one side.

The main tackles are lashed one to each spar well above the centre of gravity, and led and worked as in the previous case.

Fig. 8.

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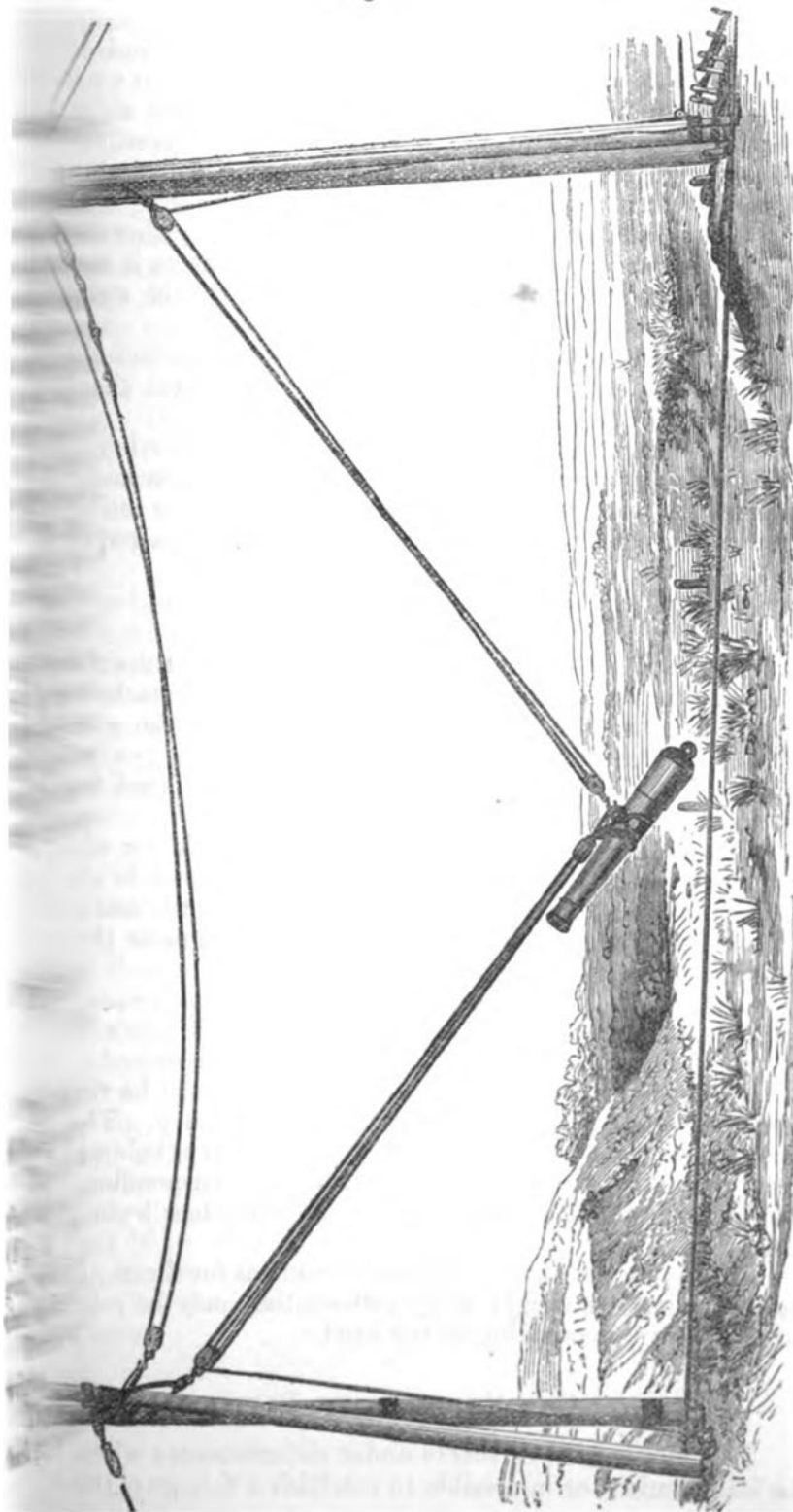
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Sheers and Derricks.

Fig. 9.



Sheers and Derricks.

GENERAL OBSERVATIONS ON THE FOREGOING OPERATIONS.

It has already been remarked that it is necessary to secure the lower blocks of the derrick main tackles well above the centre of gravity of the sheers, or about two-thirds of their length up the spars measured from the butts; but in cases where it becomes necessary to get more lift, the centre of gravity of the sheers may be brought nearer their feet by weighting the butts of the spars, either by making use of a heavy spar instead of a light uphir to lash across them, or else by slinging heavy projectiles or weights of any kind to them. The points of suspension may then be shifted nearer the feet.

The difficulty is thus met, not by getting more lift, but by obviating the necessity for having so much.

Should, however, this expedient prove barely sufficient, and the feet of the sheer spars not quite clear the top of the work, they may be raised by heeling out the derrick a little more, then hauling in on the sheer fore guy and easing up its back guy; by thus depressing the head the feet are raised, the spars revolving round the points of suspension. As soon as the feet of the sheers are found to clear the edge of the work, the derrick is heeled in until they are over the shoes, into which they are then lowered.

PASSING GUNS OVER DITCHES BY MEANS OF
TWO SHEERS OR DERRICKS.

Two sheers may be used to pass guns over ditches in the following manner:—

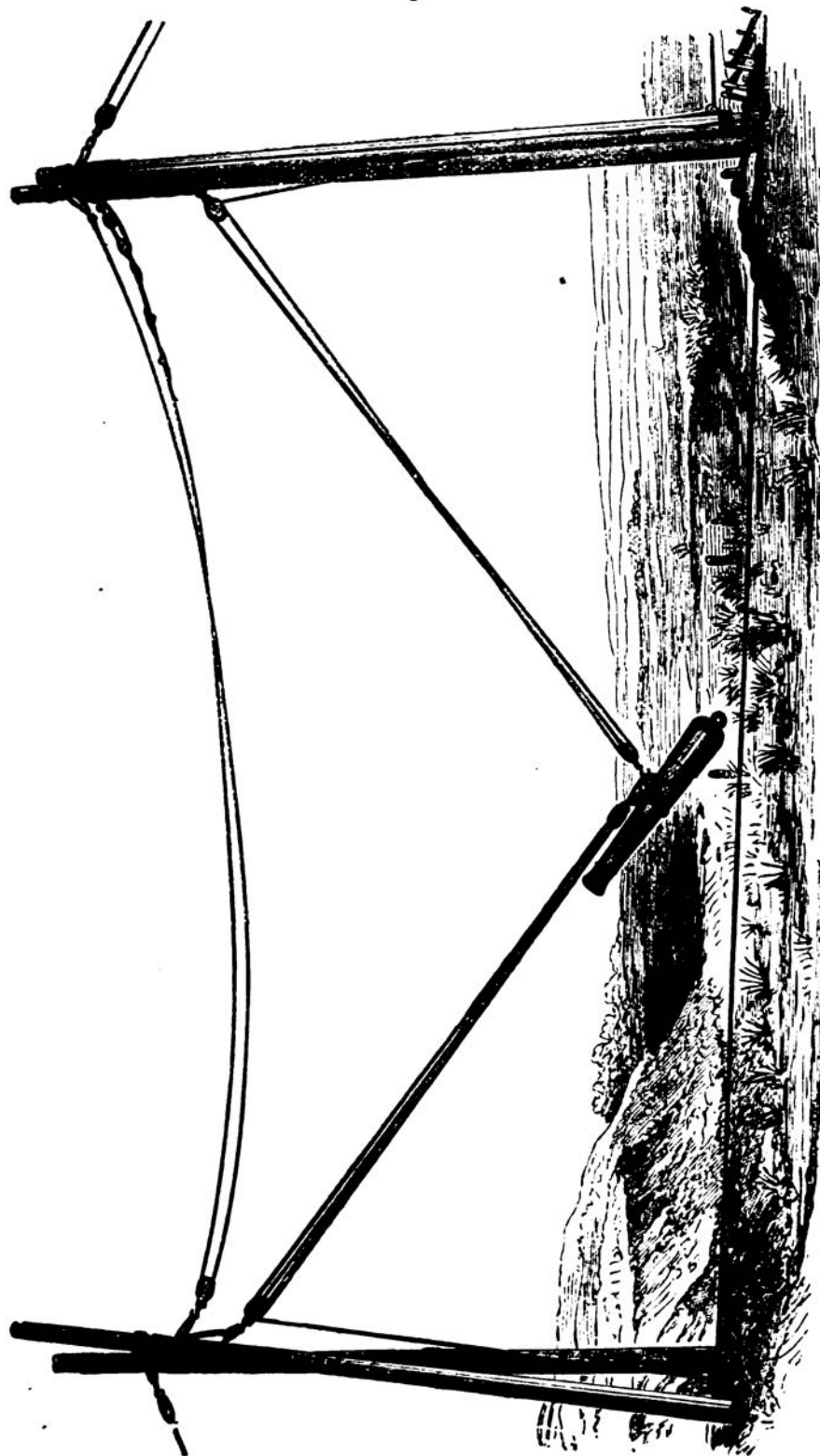
They are erected on either side in the ordinary way, except that only one guy is necessary for each, the heads being connected. (Fig. 9.) When raised the main tackles are made fast to the gun, which is passed across by hauling on one tackle, at the same time slacking off the other.

Derricks may also be used for the same purpose with light weights.

They should be slightly inclined outwards, as the strain on the back guy is sometimes excessive.

Sheers and Derricks.

Fig. 9.



 Sheers and Derricks.

GYN SHEERS.

When it is practicable to establish both a fore and a back guy, gyn sheers are generally rigged and worked without a prypole, but when a back guy only can be used, they are rigged with a lengthened prypole in the manner hereafter described; in the former case they are distinguished by being called simply "gyn sheers," and in the latter "gyn sheers with prypole."

Gyn sheers are especially applicable in cases where—

1. The space for preparing and working sheers is small.
2. When it is only required to lift or lower the weight a short distance, measured horizontally, from the feet.
3. In cases where it is possible to plant the feet close to the edge of the scarp or work, as the angle of heel should not be extreme.

The weight to be raised will determine whether an 18-foot light or heavy gyn should be used; in the former case the stores will be the same as for light, and in the latter for medium sheers, except that no head lashing or main tackle sling is required.

TO PREPARE AND RAISE.

The O.P. gyns (with shackle) are most suitable for gyn sheers, the shackle forming a ready means of attachment for the upper block of the main tackle, and throwing the weight on the head bolt close to its points of support in the gyn cheeks. A block of wood is used to fill the space on the head bolt usually occupied by the prypole.

If a N.P. gyn (with forked prypole) is made use of, the heads of the cheeks should be closed in as much as possible on the head bolt, only just enough room being left to hook the main tackle on to the bolt, which would be unduly strained unless the points of support were thus brought close together.

The cheeks are put together without the windlass, cross-bars, or prypole, the place of the latter on the head bolt being filled, if the gyn is O.P., with a block of wood as already described.

The strength of the guys and main tackle will be regulated by the weight to be lifted and angle of heel necessary. The guys are fixed to straps at the head of the gyn; the straps being of strength proportionate to the guys. The method of suspending the main tackle with the different natures of gyns has been previously described.

All the rest of the details are the same as for sheers, except that from the smaller weight of gyn sheers they may be raised by one of their guys, men lifting at the head.

GYN SHEERS WITH PRYPOLE.

If a gyn is used as sheers under circumstances when it would be inconvenient or impossible to establish a fore guy, the difficulty

Sheers and Derricks.

is met by lengthening the prypole by strongly lashing another spar to it, which spar should be about 20 feet in length. The prypole thus lengthened serves as a strut in rear, and acts instead of a fore guy.

The gyn is put together in the ordinary manner, but without windlass, the cheeks being to the front.

The back guy is arranged as for ordinary sheers, the strap for its block being placed flat over the head of the gyn; the ends are crossed underneath, brought up over the head towards the rear, and the block hooked into the bights.

To the end of the lengthened prypole the moveable blocks of two tackles are made fast, the standing to the feet of the cheeks.

The tackles, which are termed side tackles, may each consist of one double and one single 8-inch Bothway block, rove with a fall of $2\frac{1}{2}$ -inch rope. The double is the moveable block. If luff tackles are employed it will be found that the fall is too short, unless a pendant (for which a heavy drag rope is suitable) be attached between the double block and the foot of the prypole.

A plank is placed for the foot of the lengthened prypole to run on.

The upper block of the main tackle is hooked to the shackle or head bolt, according as the gyn is O.P. or N.P.

The sheers are raised by hauling on the two side tackles, at the same time easing off the back guy, and lifting at the head.

When they have sufficient heel, the side tackles and back guy are made fast.

The running end of the fall of the main tackle is then led through a leading block, lashed to the foot of one of the cheeks, to the capstan.

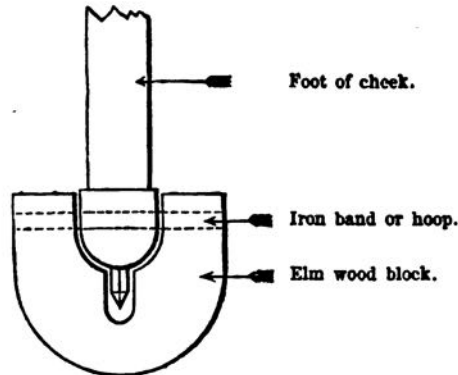
The weight is raised by the capstan to the height required, the back guy hauled on, and the side tackles eased off, until the weight is brought in, above where it is to rest, and lowered.

Both in the case of gyn sheers, and gyn sheers with prypole, difficulty is occasionally experienced in arranging for the support of the feet of the gyn cheeks, the iron spike at their extremity rendering it unadvisable to place them in a shoe such as is used for the feet of sheer spars. On ordinary ground the difficulty may be met by lashing a spar across the foot of the cheeks; the spar, by taking a bearing on the ground, prevents the cheeks sinking. On masonry, however, the spar will not keep the spike clear; in such a case the following expedient has been found to answer well; a hemispherical block of elm, iron bound to prevent it splitting (Fig. 10), is fitted to receive the foot of each cheek.

The feet thus shod are placed in sheer shoes, and work in the ordinary manner.

Sheers and Derricks.

Fig. 10.



Gyn shoes are not adapted for heeling spars on. Two 4-inch or 6-inch pieces, placed fore and aft close on either side of the spike, and lashed together to prevent their opening, answer fairly to support the feet of the gyn cheeks.

LEVER SHEERS.

Lever sheers are very rarely used, for the following reasons:—

1. Gyn sheers, or gyn sheers with prypole, are easier to prepare and work, and will raise a heavier weight, and instances are but few where a gyn cannot be procured for the purpose.

2. The employment of a spar, or a composite spar in the manner adopted in lever sheers, subjects it to a cross-breaking strain of the most trying nature, hence it is only applicable for raising comparatively light weights, say 5 tons *at the outside*.

3. They cannot be heeled in or out, hence the weight can only be picked up a short distance out, for the counter lever must be kept short on account of the strain on the spar and the difficulty that would be experienced with a long counter lever in bringing the suspended weight inboard.

In case, however, it should be decided to erect lever sheers, the mode of procedure will be as follows:—

The stores are nearly the same as those for ordinary sheers, except the spars; only one back guy is required.

GENERAL DUTIES OF SECTIONS.

- No. 1. Lever.
- No. 2. Foot of lever.
- No. 3. Crutch.
- No. 4. Back guy.
- No. 5. Main fall, leading block, sling and steadying ropes.
- No. 6. Crab capstan.

A crutch of any desired height is prepared like sheers.

A long spar is laid on this, having the upper block of the main tackle made fast to its outer end. A strap for the block of the

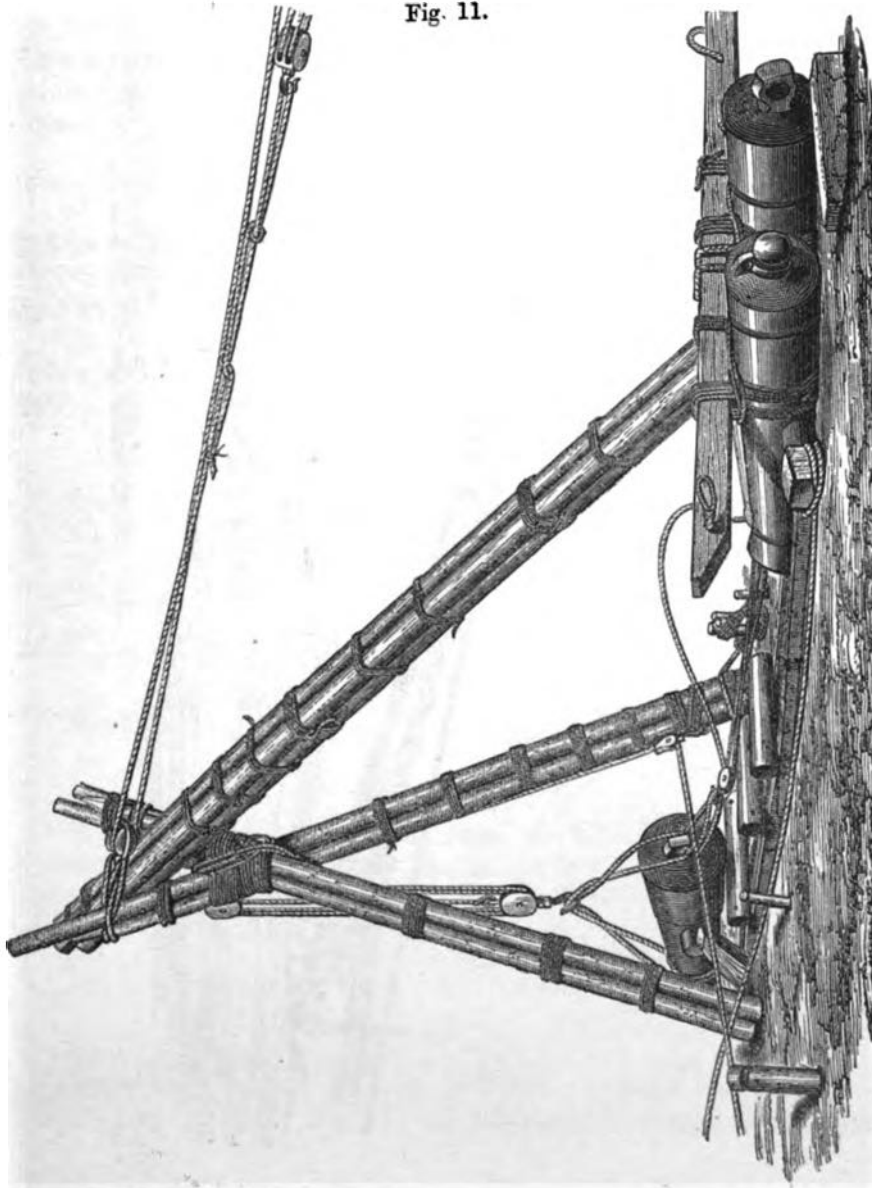
Sheers and Derricks.

back guy is then laid over the long spar behind the crutch; the bights led down one on each side under the crutch, up and over it to the rear; or it is placed on the long arm close in rear of the crutch, one bight led round each point of the crutch from outwards, inward meeting towards the rear; into the bights thus formed the block is hooked.

The foot of the long spar is firmly butted into the ground to prevent its slipping back, and is kept from rising by being lashed to pickets, driven in across it, or by being weighted. Should the weight to be taken be so great as to make the centre of the spar liable to buckle, it will be as well to lash it to a weight on the ground.

The lever and crutch can be formed of either single spars, or smaller spars lashed together. (Figs. 11 and 12.)

Fig. 11.



Sheers and Derricks.

Fig. 12.



Sheers and Derricks.

They can be prepared on the ground and raised by tackles the moveable blocks of which are made fast to the inner end of the long spar, on the same principle as with gyn sheers with lengthened pry-pole.

To guard against the crutch capsizing to a flank in raising, light side guys may be employed.

DERRICKS.

Derricks are used for lighter weights than sheers, also to raise sheers themselves. They may be used singly or in combination.

Their advantage is that when the weight is taken it can be slewed through a considerable space and then lowered.

Derricks are of two descriptions, the "Standing" and "Swinging."

In every case the size of the spars, cordage, and holdfasts must depend on the purpose to which it is to be applied.

A "Standing" is used when a direct lift or slight lateral play is required.

A "Swinging" when much lateral play is to be given and lighter weights raised.

Four guys are generally used; sometimes, when specific work is to be done, three guys can be made sufficient.

The detachment required is the same as for ordinary sheers. It is also told off in the same way, and the sections perform the duties as under.

GENERAL DUTIES.

- No. 1. Head of derrick.
- No. 2. Foot of derrick.
- No. 3. Fore guy.
- No. 4. Back guy.
- No. 5. Main tackle, leading block, sling and steadying ropes.
- No. 6. Crab capstan.
- No. 7. Right guy.
- No. 8. Left guy.

TO ARRANGE STORES.

The stores required are the same as for ordinary sheers. In addition, two side guys, with blocks for head, two runner tackles, and two selvagees for the same; also, holdfasts are required, and only one spar and shoe is required.

The stores are brought up by the sections that use them.

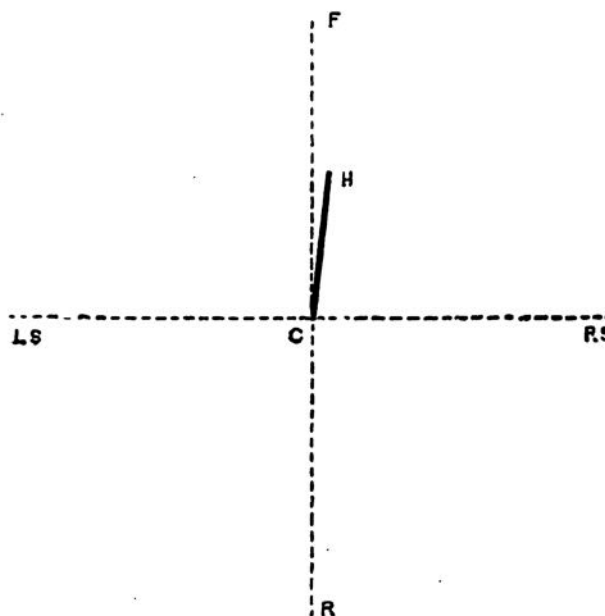
TO PREPARE DERRICKS.

The position of the foot and holdfasts for guys should be first marked out; this will depend very much on the length of the spar.

Sheers and Derricks.

The following should be as closely adhered to as possible.

Fig. 13.



CH is the spar.

F, the fore guy holdfast.

R, the back guy holdfast.

RS, right side guy holdfast.

LS, left side guy holdfast.

CF, CR, CLS, CRS, or distance to holdfasts = 2 CH.

Length of guys = 4 CH.

The spar is laid in any desired position with a support for its head.

It is seldom, if ever, necessary to rig a derrick with more than two running guys, the others being standing guys; the latter being only called on to allow of a *slight* lateral heel, sufficient to admit of the suspended weight clearing the spar when swinging from front to rear, or *vice versa*, and not often that, as this can generally be effected by the steadying ropes or tackles without giving lateral heel at all; the following instructions are therefore framed to apply in the case of a derrick rigged with running fore and back guys and side guys consisting of one return of rope with luff tackle at their lower extremity.

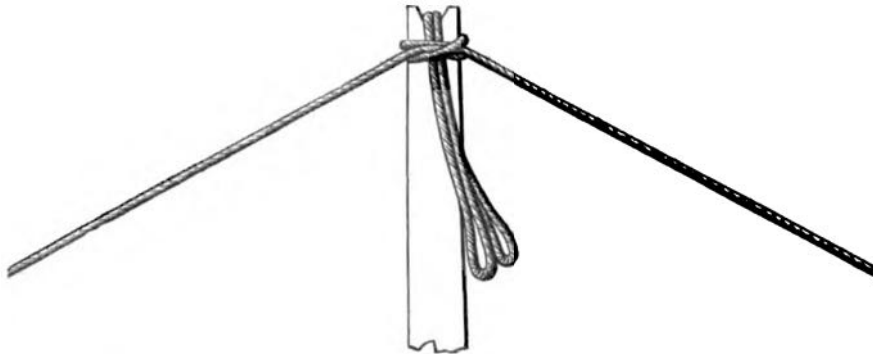
TO RIG THE HEAD.

A slot is cut in the upper surface of the head of the spar for the sling of the main tackle, its sharp edges should be rounded off to prevent the sling being cut.

Sheers and Derricks.

The spar should be so placed that the slot lies, fore and aft, in the vertical plane in which the head of the derrick will move in heeling.

Fig. 14.



Rear view of Derrick, when raised, showing mode of attachment of side guys. The head lashing is omitted to show the arrangement of the sling for the main tackle.

The centre of the main tackle sling should be placed in the slot, the bights being laid along the spar and temporarily secured by a light lashing.

The lashing for securing the guy blocks at the head of the derrick may consist of about 10 fathoms of $2\frac{1}{2}$ -inch rope and be applied in the following manner:—

A timber hitch is made round the head of the spar a few inches below the slot, and a complete round turn taken; the single or snatch blocks of the fore and back guys are then held in the positions they will occupy, and as many returns of the lashing taken round their hooks as may be deemed sufficient.

The number of returns should be regulated by the weight to be taken and angle of heel anticipated. Five or six will generally prove sufficient. The spare end of the lashing rope is utilized by applying it as a collar round the spar below the hooks, the end being brought up and made fast above them.

The fore and back guys and their runner tackles are the same as with light sheers. (Page 646.)

The anti-twisters for the guy blocks may be made fast to the head of the spar or the side guys.

The side guys (for which one half coil of rope, put on with a clove hitch on its centre over the head of the spar, above the head lashing, generally answers well) may, as before stated, be fitted with luff tackles at their lower extremities.

A shoe is sunk for the foot in the same way as for sheers.

TO RAISE THE DERRICK.

To raise the derrick the two side guys are hauled in and made fast while it is on the ground.

The same means are then used as for raising sheers.

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Sheers and Derricks.

"SWINGING" DERRICK.

The detachment is the same as for a "Standing" derrick.

GENERAL DUTIES.

The general duties are the same except that No. 1 section attends to the head of the swinging spar and its tackle in addition to the duties detailed for a "Standing" derrick, and No. 2 attends to the feet of both spars.

TO ARRANGE STORES.

The stores required are the same and brought out by the same sections as for a "Standing" derrick, and in addition the following: one spar and shoe, with pickets if necessary, one long rope for the side guys, holdfasts, and one main tackle for the swinging spar.

TO PREPARE A "SWINGING" DERRICK.

An upright spar is prepared the same as for a "Standing" derrick.

A swinging spar is then prepared with a main tackle as in the "Standing" derrick, and is connected to the upright by the main tackle of the "Standing" derrick, at the most convenient distance from the head. Its foot is supported in a shoe at the foot of the "Standing" derrick inclined so as to be as nearly as possible at right angles to its general direction, or its butt end is supported by being lashed to the upright.

It is steadied by side guys from the head, and when the angle of its swing is great the foot, if in a shoe, should be provided with preventer ropes. This angle ought not to exceed 60°.

TABLE OF STRAINS AND THRUSTS AT 10° AND 20° HEEL, AND MOTIVE POWER NECESSARY IN WORKING THE FOUR NATURES OF SHEERS.

In the following Table the shortest spar and greatest weight named for each nature of sheers has been taken as an example. The spars are supposed to be of Riga pine. It is taken for granted, in each case, that the gear is in thorough working order, and anti-twisters applied to blocks where necessary.

1	2	3	4	5	6	7	8	9	10	11	12	13
Nature of Sheers.	Weight of Gun.	Stores required.	Total weight affecting strain on running end of main fall, viz., Gun, sling, and lower block or blocks.	Total weight affecting strain on back of gun (when heeled to the front), viz., Gun, sling, main fall, tackle, 1/4 weight of spars, head gear, and portion of fore guy.	Total length of Spar.	Length of Spar to Crutch.	Mean diameter of Spar.	Theoretical power for raising the weight.	Strain on the running end of main fall or falls, 1/4 of weight added for friction of each sheave.	Power each of 4 or 8 men must exert on capstan or winch, or each of two winches, to raise the weight (friction of winch, 40 per cent.)	Theoretical power for controlling Guy.	Strain on back Guy and thrust on Spar when the weight is suspended.
												Heel 10°. Heel 20°.
Light sheers, with head bolts and wire guys	Tons. 5	Vide Page 646	5 tons 1 cwt.	5 tons 18 1/2 cwt.	Feet. 20	Feet. 30	Inches. 13	Main fall 6 to 1 Crab capstan 13 to 1 Total 78 to 1	1 ton 13 cwt.	8 men, each 35 lbs.	Guy tackle 6 to 1 Crab capstan 13 to 1 Total 78 to 1	Strain 27 cwt. Thrust 130 cwt. Strain 56 cwt. Thrust 150 cwt.
Medium sheers, with head lashing and rope guys	12	Vide Page 654	12 tons 3 cwt.	14 tons 7 cwt.	40	35	16	Main fall 6 to 1 Crab winch (2 tons), with messenger 72 to 1 Total 432 to 1	4 tons	4 men, each 44 lbs., or 8 men, 22 lbs., not taking the messenger into account	Guy 3 to 1 Runner 4 to 1 Capstan 13 to 1 Total 156 to 1	Strain 62 cwt. Thrust 135 cwt. Thrust 16 tons Strain 18 tons
Heavy sheers, with head lashing and wire guys	25	Vide Page 656	25 tons 6 cwt.	28 tons 18 cwt.	50	42	20	2 main falls 6 to 1 Two crab winches (2 tons), with messenger 72 to 1 Total 432 to 1	4 tons 3 cwt.	4 men, each 45 lbs., or 8 men, 22 1/2 lbs., not taking the messenger into account	Guy tackle 6 to 1 2-ton winch 72 to 1 Total 432 to 1	Strain 6 1/2 tons. Thrust 13 1/2 tons. Thrust 32 tons Strain 36 tons
Heavy sheers, with head bolts and wire guys	38	Vide Page 654	38 tons 8 cwt.	44 tons 6 cwt.	60	60	24	Two main falls 6 to 1 Two crab winches (6 tons) 140 to 1 Total 840 to 1	6 tons 6 cwt.	8 men, each 17 lbs.	Guy tackle 7 to 1 5-ton winch 140 to 1 Total 990 to 1	Strain 9 tons. Thrust 20 1/2 tons. Thrust 8 cwt. Thrust 55 tons Strain 49 tons

N. B.—In calculations for spars and tackle varying in length and weight from the above, 1/4th of the weight of the gun can be added to the weight of the gun itself, in considering the strain on guys and thrust on spar, this proportion having been found to agree approximately with the actual weights taken into consideration in column 5. With the longest and heaviest spars used for each nature of sheers, 1/4th of the weight of the gun should be added. At out-stations, winches giving a different mechanical advantage may be met with. In the calculations, a leading block is taken into account for guy runners or tackles led to a capstan, but not for those led to a winch.

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